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The SARRNET cassava component

An impact assessment report

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Acronyms and abbreviations

ASNAPP	Agribusiness in Sustainable African Plant Products
AYT	advanced yield trial
CBB	Cassava Bacterial Blight
CBO	community based organization
CBSD	Cassava Brown Streak Disease
CE	clonal evaluation
CIP	International Potato Center
CLAYUCA	Consorcia Latinoamericano y del Caribe de Apoyo a la Investigacion y Desarrollo de la Yuca (Latin American Consortium for Cassava and development)
CM	cassava mealybug
CMD	Cassava Mosaic Disease
CMRTA	Chinangwa–Mbatata Root and Tuber Association, Malawi
CNFA	Citizen Network for Foreign Affairs
CT	Chinyanja Triangle
DARS	Department of Agricultural Research and Services
EARRNET	Eastern Africa Root Crops Research Network
ESARRN	East and Southern Africa Root Crops Research Network
FANRPAN	Food, Agriculture and Natural Resources Policy Analysis Network
GTZ/IFSP	German Agency for International Cooperation/Integrated Food Security Project
ha	hectare
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
ICRAF	International Centre for Research in Agroforestry
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IEHA	Initiative to End Hunger in Africa
IITA	International Institute of Tropical Agriculture
IR	intermediate result
MEDI	Malawi Entrepreneurs Development Institute
MTL	maximum tolerated levels
NARS	national agricultural research systems
NASFAM	National Smallholder Farmers Association of Malawi
NRI	Natural Resources Institute, UK
OP	open pollinated
PIM	Packaging Industries Malawi Ltd.
PYT	preliminary yield trial
SA	Southern Africa
SN	seedling nursery
SADC	Southern Africa Development Community
SARRNET	Southern Africa Root Crops Research Network
TSBF-CIAT	Integrated Soil Fertility Management in the Tropics–International Center for Tropical Agriculture
TLC	total land care
USAID	United States Agency for International Development
UYT	uniform yield trial

Executive summary

The International Institute of Tropical Agriculture (IITA) and the Southern Africa Root Crops Research Network (IITA/SARRNET) and its partners implemented a project called *Improving rural livelihoods in southern Africa* from 2003/2004 to 2008/2009 with financial support from USAID. The project was implemented in the Chinyanja Triangle (CT) and Angola with the objective of improving rural livelihoods. It responded to Intermediate Result 2 which aimed at diversifying agricultural production in vulnerable communities to enhance food and income security through root and tuber crops. The project strategy was the introduction of market-led root crop technologies, mass production and dissemination of planting materials, development, introduction, promotion, and dissemination of new cassava varieties, products, and processing technologies. This report gives a synthesis of the results of a literature review and a field study that were undertaken to assess the adoption and impact of the cassava research for development intervention implemented in parts of Malawi, Zambia, and Mozambique.

The project distributed about 44,412 bundles (2,220,600 stems) of Mbundumali, Maunjili, Sauti, Yizaso, Mkondezi, and Silira in Malawi; Nikwa, Mulaleia, Chigoma mafia, Likonde, Chinyembwe, Munhaca, Seis meses, and TMS30001 in Mozambique; and Mweru, Chila, Tanganyika, Kapumba, and Mbundumali in Zambia, enough to cover over 683 ha. The project introduced and evaluated new germplasm for adaptability to different agronomic conditions such as mono- and intercropping, resistance to common cassava pests and diseases, root yield and yield characteristics, and acceptability for market needs. Labor-saving technologies, such as chippers, graters, leaf choppers, solar driers, pulverizers, and peelers, were introduced, demonstrated, and disseminated for processing food and nonfood products. A pulverizer increased starch extraction rates from 15 to 20%. Solar driers reduced the time required for drying starch from 3 days to 1 day, enabling farmers to dry up to 3 t/week of starch as opposed to 1 t/6 days under direct sun drying. Peelers were found to increase peeling efficiency by 12%. Over 29 technologies, including new varieties, management practices, and processing methods were made ready for transfer and 2910 farmers and 100 processors adopted them. Altogether, 4614 males and 2920 females were trained in aspects of cassava production and processing. In total, 10,843 rural households, 8743 vulnerable households, 21 agriculture- related firms, and 36 producer organizations, business associations, and community-based organizations (CBOs) directly benefited from the project's interventions. Twenty-seven partner organizations participated in the project and 24 public–private partnerships were formed.

A survey was undertaken to assess the adoption and impacts of the cassava research for development intervention implemented in parts of Malawi, Zambia, and Mozambique between 2004 and 2009 as part of a larger project on Improving rural livelihoods in southern Africa. A total of 617 households was randomly selected and interviewed (476 cassava growers and 141 non-growers) from Malawi (302), Zambia (155), and Mozambique (160). The survey gathered primary information on farm assets, cassava production, household incomes and food security, awareness and adoption of new varieties, improved management practices, and processing technologies.

Most households owned hoes (98.7%), pangas/cutlasses (65.8%), and bicycles (55.8%). Ownership of these assets was not different between cassava growers and non-growers. Cassava growers owned slightly more land (1.89 ha) than non-growers (1.67 ha). Farming was the primary source of income for both growers (89%) and non-growers (91.5%). Own business was the second major source of income for non-growers (43.5%) and growers (37.4%). The estimated annual income from livestock and crops did not differ between growers and non-growers.

Lack of planting materials (42.3%), land shortage (25%), labor shortage (12.5%, and lack of interest (10.6%) were the main reasons for farmers not growing cassava. About 18% of growers started to grow cassava between 1990 and 1999; 69% between 2000 and 2009, and of the latter group, 53% started between 2004 and 2009. More farmers (60.5%) grew cassava under monocropping, followed by intercropping (10%), mixed cropping (5%), and relay cropping (1.3%).

About 26% of growers increased their area under cassava during the 2 years before the survey. The average area under improved varieties increased by 23% (from 0.168 to 0.2 ha); local varieties by 12.6% (from 0.35 to 0.4 ha); and mixed varieties by 12.56% (from 0.061 to 0.068 ha). Production of local varieties increased by 40%, of improved varieties by 83%, and of mixed varieties by 21%. IITA/SARRNET was the major source of seeds in Malawi (54%) and in Zambia (53%). Farmers were the primary source of planting material in Mozambique (62.8%) and the second major source in Malawi (20%) and Zambia (24.5%). More growers (60%) produced food enough for the whole year than non-growers (47%). Over 39% of cassava growers received training on various aspects of cassava production and processing; 4% of them were trained between 1983 and 1999; 9% between 2000 and 2003; and 82% between 2004 and 2009.

1. Introduction

Between 2003 and 2009, IITA/SARRNET and its partners implemented a project on Improving rural livelihoods in southern Africa with financial support from United States Agency for International Development (USAID). This project built on the previous SARRNET activities and other projects in the region. It responded to Intermediate Result 2 which aimed at diversifying agricultural production in vulnerable communities to enhance food and income security through root and tuber crops. The project strategy was the introduction of market-led root crop technologies, mass production and dissemination of planting materials, and the development, promotion, and dissemination of new cassava varieties, products, and processing technologies. This report gives a synthesis of the results of a literature review and a field survey undertaken to assess the adoption and impact of the cassava research for development intervention implemented in Angola and some parts of Malawi, Zambia, and Mozambique. The report highlights major activities implemented, achievements, and limitations, and draws lessons learnt and their implications for the future strategy for cassava research for development interventions. In 2003/2004, the project covered Tanzania which was later coordinated by the Eastern Africa Root Crops Research Network (EARRNET) and hence it is not included in this report.

The rest of the report is outlined as follows: Section 2 review the major activities undertaken between 2004 and 2009. It first outlines the evolution of SARRNET, focusing on activities in Phase I and II. Section 3 outlines the methodology for field impact assessment undertaken in the CT. Section 4 presents the results focusing on households and farm characteristics, cassava production, processing, capacity building, and marketing. Finally, section 5 concludes the report and presents major implications for the future strategy for cassava research for development interventions.

2. About SARRNET

Evolution of SARRNET

SARRNET was inaugurated in 1994 following the division of East and Southern Africa Root Crops Research Network (ESARRN) into SARRNET and EARRNET. SARRNET is the network for the 12 Southern Africa Development Community (SADC) countries and works under the SADC–FANR (Food, Agriculture, and Natural Resources) directorate. USAID through the Regional Center for Southern Africa (RCSA) has been the main sponsor for SARRNET's activities. SARRNET operated in two phases before the phase under current review.

In Phase I (1994–1998), SARRNET's major goal was to improve the food security of resource-poor households in the southern African region through increasing cassava and sweet- potato production and utilization. SARRNET promoted the adoption of improved varieties and practices and strengthened the capacity of national root crops research programs in the SADC region. The major activities were research, information and technology exchange, and training and institutional capacity building. The major research themes were developing and/or introducing and evaluating improved germplasm; surveying production systems and developing postharvest technologies; managing pests and diseases through an ecologically sustainable plant protection approach; and establishing systems for the rapid multiplication and distribution of improved planting material and technologies.

In Phase II (1999–2003), SARRNET built on the activities of Phase I and shifted the focus to a demand-led research and development in cassava and sweetpotato crops with a strong bias on income generation, private sector participation, and food security. Phase II was jointly developed in 1999 by representatives of the member countries, IITA, CIP, and USAID/RCSA. According to Mahungu et al. (2004), SARRNET Phase II included three major themes: (i) food security through supplying planting materials of super lines associated with adequate crop husbandry in areas prone to drought and other climatic shocks; (ii) income generation and equity through adding value to cassava and sweetpotato in rural and peri-urban centers for small-scale farmers; and (iii) import substitution by increasing the industrial application of cassava and sweetpotato products, such as flour, starch, and glue.

The phase under current study (2004–2009) continued the work of the past phases and expanded its market-led research for development activities in collaboration with National Agricultural Research Systems (NARS) and other stakeholders, including farmers, non-governmental organizations (NGO), universities, and the private sector. This approach recognized the potential benefits from transforming cassava into broad-based value-added products for sustained food security, nutrition, and income generation.

SARRNET activities during Phases I and II

SARRNET made a considerable impact in cassava production and utilization in the SADC region. It initiated major programs on cassava and sweetpotato germplasm development, seed multiplication and distribution, the development of postharvest technology, and the promotion of the utilization of cassava products in the food and nonfood sectors. About 73 ha of cassava and 647 ha of sweetpotato were planted for seed multiplication and distribution and/or sale to farmers. These programs helped to spread clean planting materials with the consequence that there was a significant and steady increase in the production of cassava and sweetpotato; cassava production rapidly expanded into non-traditional areas (Mahungu et al. 2004; Jumbo et al. 2007). The area under improved sweetpotato varieties increased from 12 to 29% and for cassava from 7 to 13.5% between 1990 and 2002 (Table 1).

Table 1. Trends in cassava production in some SARRNET countries during Phase I and II.

Year	Angola		Malawi		Mozambique		Tanzania		Zambia	
	Area*	Production	Area	Production	Area	Production	Area	Production	Area	Production
1990	400	1600	61	144	944	4590	590	7792	103	640
1991	407	1640	71	167	972	3690	604	7460	110	682
1992	440	1861	63	128	973	3238	683	7112	110	682
1993	440	1861	75	216	842	3511	657	6832	120	744
1994	406	2379	72	250	908	3351	693	7209	120	744
1995	500	2550	94	328	985	4178	584	5968	120	744
1996	520	2500	116	534	993	4734	588	5993	120	744
1997	526	2326	125	713	991	5336	633	5704	113	702
1998	576	3210	151	829	1015	5639	745	7033	131	816
1999	523	3129	166	895	958	5352	655	7181	170	970
2000	534	4433	180	2757	925	5361	809	7120	165	815
2001	573	5394	198	3313	930	5400	660	6884	165	950
2002	575	5400	102	1540	930	5400	660	6888	165	950

*Area (000 ha) and production (000 t). Source: Mahungu et al. 2004.

Table 2. Cassava varieties released in Angola, Malawi, Mozambique, and Zambia in Phase I and II.

Variety/local name	Source/origin	Place and year of release
Manyokola	Malawi	Malawi, 1999
TMS 91934 (Maunjili)	IITA (Nigeria)	Malawi 1999
TMS 60142 (Silira)	IITA (Nigeria)	Malawi 1999
MK91/478 (Mkondezi)	Local selection from IITA	Malawi 1999
CH92/112 (Yizaso)	Malawi IITA	Malawi 2002
CH92/077 (Sauti)	Malawi IITA	Malawi 2002
Bangweulu	Zambia	Zambia 2001
Nalumino	Zambia	Zambia 2001
Kapumba	Zambia	Zambia 2001
TMS42025	IITA	Mozambique 2002
TMS30001	IITA	Mozambique 2002
TMS30395	IITA	Mozambique 2002
TMS60142	IITA (Nigeria)	Angola 1994
M96000910	IITA (Nigeria)	Angola 1994
TMS 40142	IITA introduction	Angola 1994

Source: Mahungu et al. 2004.

IITA/SARRNET focused on participatory variety selection to address specific market needs. Sixteen cassava varieties (Table 2) and seven sweetpotato varieties were released to address the needs of the fresh and industrial markets and to combat the emerging threat of diseases and malnutrition (especially vitamin A deficiency) (Mahungu et al. 2004). For example, about 100,000 families in Mozambique, Tanzania, and Malawi benefited from the distribution of orange-fleshed sweetpotato planting materials to combat vitamin A deficiency.

Both phases promoted the development and dissemination of postharvest technologies on cassava and sweetpotato to save labor and improve the quality and value of the end products. Starting from a rudimentary position, SARRNET identified market opportunities and challenges, especially in assessing and improving product quality and processing technologies and in market development.

In Phase II, 79 processing technologies[1] comprising graters, chippers, and slicers were introduced in Malawi, Zambia, and Tanzania. The demand for cassava products increased from 7000 t in 1999 to 12,000 t in 2003 as a result of the functional models initiated by IITA/SARRNET to commercialize the cassava sector. Private cassava and sweetpotato seed producers increased from 2 in 2001 to over 20 firms/individuals in 2003.

IITA/SARRNET in partnership with CIAT/CLAYUCA and in collaboration with Land O'Lakes in Malawi also conducted research on livestock feed in Tanzania and Malawi. Cassava silage which was made up of 80% leaves and 20% roots was found to be a good feed for dairy animals. In Malawi, the feed doubled milk yield during the dry season from an average of 6 to 13 L/animal/day.

In partnership with Save the Children Federation (USA), IITA/SARRNET carried out joint activities with cassava and sweetpotato to assist people caring for the terminally ill patients and orphaned children in Malawi. A total of 206 men and 98 women were trained in seed multiplication, agronomy, processing, and utilization, and in HIV/AIDS prevention. Nurseries were established, about 18.8 ha of cassava and 11 ha of sweetpotato, which benefited about 6000 vulnerable households in Phase II.

In Phase II, SARRNET also developed an effective information sharing and technology dissemination mechanism through publishing the ROOTS newsletter, creating the SARRNET webpage, holding steering committee meetings; sponsoring symposia and workshops, and producing technical reports. These activities continued in the livelihood project under current review.

All these activities were combined with capacity building to enhance manpower in root and tuber crop research and development. A total of 2 PhD, 6 MSc, and 5 undergraduate students were trained. Thirty short courses on various themes, such as breeding, management, statistical data analysis, postharvest management, integrated pest management, and seed multiplication, were organized that benefited 511 trainees (Mahungu et al. 2004).

Cassava production beyond Phase II

The momentum in cassava production generated in Phases I and II of SARRNET activities in SA was sustained over the years (Fig. 1). Market studies conducted in Zambia, Malawi, and Mozambique (e.g., Mahungu et al (eds) 2001; IITA/SARRNET 2003; Haggblade and Zulu 2003); Barratt et al. 2006; Chitundu et al. 2006; Haggblade and Nyembe 2007) attribute the surge in cassava production to the increased area under cassava,

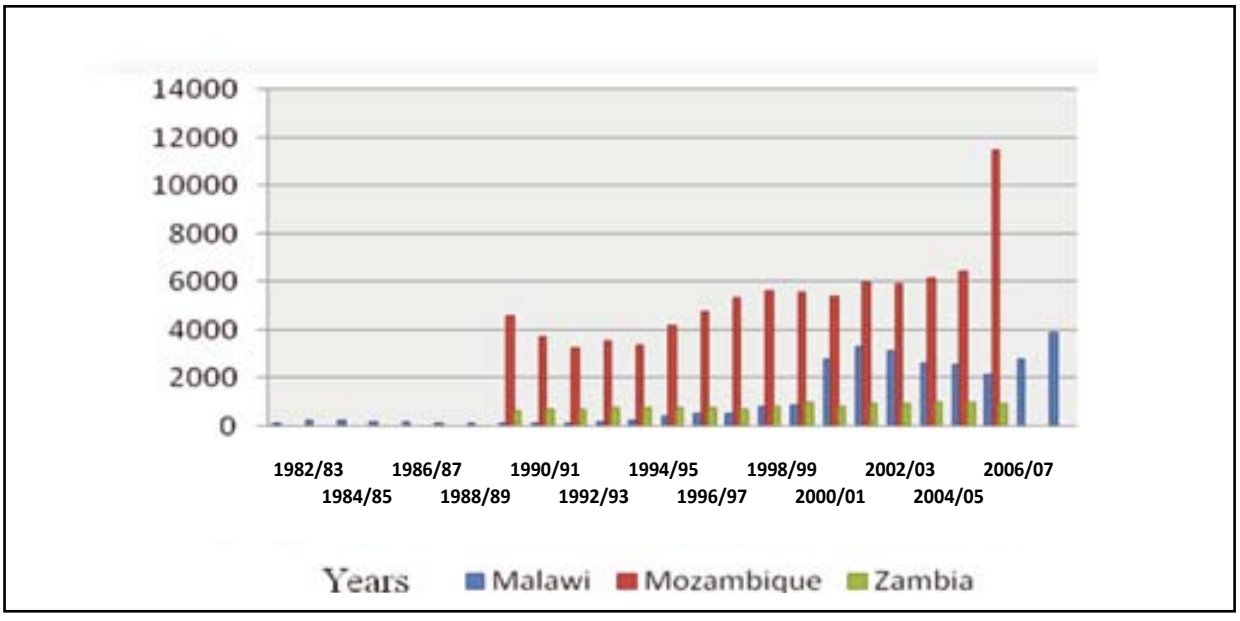

Figure 1. Cassava production in Malawi, Zambia, and Mozambique.
Source: Kambewa and Mahungu 2007.

[1] For a detailed analysis of the contribution of SARRNET in phases 1 and 2, see Mahungu et al. 2004 and Jumbo et al. 2007.

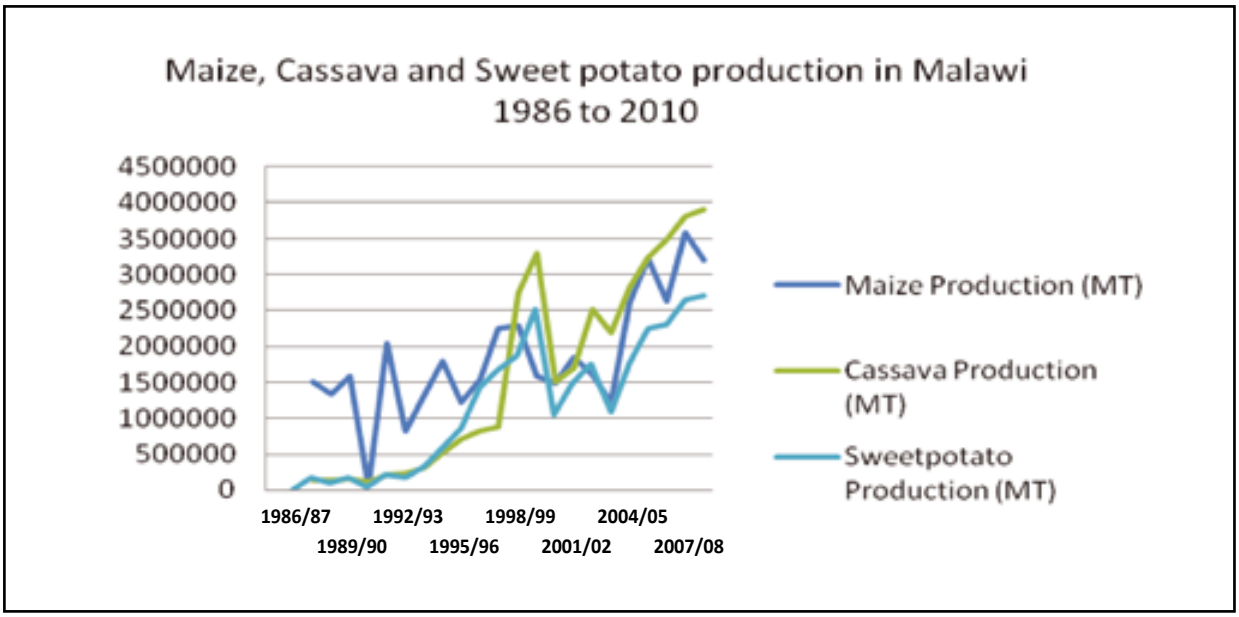

Figure 2a. Annual maize, cassava, and sweetpotato production in Malawi, 1986 to 2010.

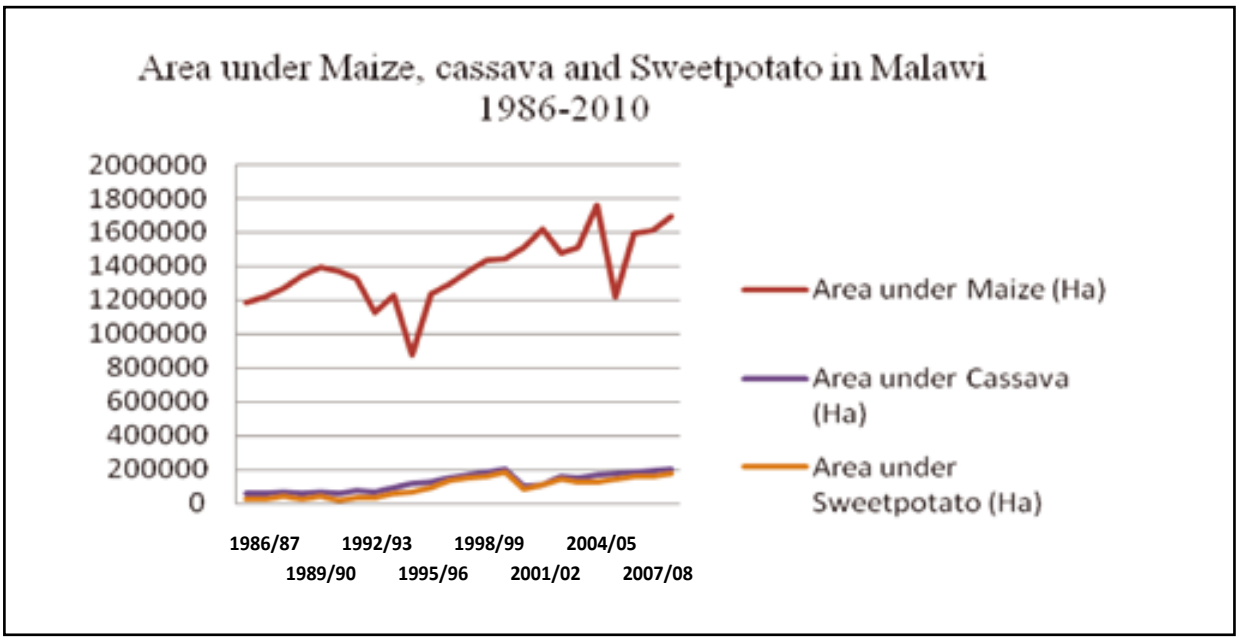

Figure 2b. Annual area under maize, cassava, and sweetpotato in Malawi, 1986 to 2010.
Source of data: Ministry of Agriculture and Food Security, Planning Section.

the development and adoption of high-yielding varieties, increased substitution of cassava for maize, especially in maize-deficit areas and years, and the increased application of cassava in nonfood industrial uses.

Malawi, for example, experienced dramatic increases in the area under cassava, yield, and production since the mid-1990s (Fig. 2). Cassava production expanded more than 9-fold from the mid-1990s to 2007, almost surpassing the production of maize and other root crops, such as potato. Rusike et al. (2009) attributed the sharp increase in average yield and production in the late 1990s to changes in the methods used for estimating cassava production from dry to wet weight. The authors, however, acknowledged that changes in methods alone could not explain the substantial growth in aggregate area, yield, and production.

The Chinyanja Triangle

The Chinyanja Triangle (CT) covers central and southern Malawi, the Eastern Province of Zambia, and the Tete Province of Mozambique. The region was named after Chinyanja—a common language along the shared borders of these countries. The CT shares a history of policy preference for maize and recently also

experienced an upsurge of cassava production for both food security and commercial purposes. The CT also experiences and often shares similar climatic disasters related to the environment, such as persistent and recurrent droughts often alternating with excessive rain and floods. These conditions over the past two decades severely affected food production, particularly of maize, thereby increasing the absolute necessity of growing drought tolerant food security crops, such as cassava. As a result, there was increasing public and private interest in and policy support to cassava production and processing in the CT2. The food security problems as well as the efforts to address them spanned entire countries.

SARRNET's activities in the CT and Angola between 2004 and 2009

The major activities that SARRNET implemented in the CT and Angola between 2004 and 2009 were: (1) Introduction, evaluation, demonstration, and dissemination of labor-saving processing machines in pilot communities; (2) Mass production and dissemination of appropriate, disease-free planting materials for cassava and sweetpotato through the establishment of primary, secondary, and tertiary nurseries; (3) Promotion of cassava-based livestock feeds; (4) Development, evaluation, introduction, and promotion of new cassava and sweetpotato varieties and products for market acceptability; (5) Introduction and promotion of yellow-pigmented cassava, orange-fleshed sweetpotato, and leaves for nutritional improvement; (6) Facilitation of regional networking by establishing and strengthening national task forces for root and tuber crops in the CT and Angola, and (7) Monitoring indicators. The current review focuses on activities related to cassava under the project Improving rural livelihoods.

Production technologies

The main strategy was the mass production and dissemination of appropriate, disease-free cassava planting materials through (1) the establishment of seed multiplication nurseries, (2) the development, evaluation, introduction, and promotion of new cassava varieties and products for market acceptability, and (3) the development of appropriate cultural practices. This section reviews the major activities and technologies developed.

Planting material multiplication. Development and multiplication of the improved cassava varieties in the previous phases continued through the establishment of strategic nurseries. The major varieties were Mbundumali, Maunjili, Sauti, Yizaso, Mkondezi, and Silira in Malawi; Nikwa, Mulaleia, Chigoma mafia, Likonde, Chinyembwe, Munhaca, Seis meses, and TMS30001 in Mozambique; and Mweru, Chila, Tanganyika, Kapumba, and Mbundumali in Zambia. Altogether, about 44,412 bundles[3] of these varieties were distributed, enough to cover over 683 ha[4]. Table 3 captures some of the nurseries established and the planting materials distributed. Quite often, the reports specified the number of nurseries established but not their sizes (in ha) nor the varieties. The units of measurement for the planting materials were not always consistent (e.g., bundles, stems, or cuttings). It was also not always clear whether the planting materials were meant for nursery establishment or for direct distribution to individual farmers.

Table 3. Cassava stems distributed and nurseries established in the CT and Angola.

Malawi (central/southern region)	Mozambique (Tete Province)	Zambia (Eastern Province)	Angola
10,922 bundles of assorted cassava varieties covering 169.0 ha	2311 bundles of cassava varieties covering 35.6 ha	2459 bundles of assorted cassava varieties covering 37.8 ha	26,720 bundles of cassava stems of cassava varieties covering over 441.8 ha

Source: SARRNET Annual reports for 2003/2004 to 2008/2009.

[2] In this study, activities conducted in Malawi, Mozambique, and Zambia refer specifically to those conducted within the CT unless other wise stated.
[3] A bundle is estimated to have 50 stems × 1 m long.
[4] The quantity of cassava planting materials and the areas summarize those that were explicit in the reports, which may be lower (or higher) due to possible double counting.

A large amount of additional planting materials was distributed through collaborative projects. For example, 3716 bundles of Mbundumali cassava stems, enough for 57.2 ha, were distributed in Lilongwe (18.3 ha), Kasungu (3.4 ha), and Mzimba (6.9 ha) on the Plan Malawi/SARRNET project Promotion of cassava as a food security crop in Malawi. An additional 1107 bundles of Mbundumali stems, enough for 17.0 ha, were distributed in Chikwawa and Nsanje districts on the Norwegian Development Fund, and 4356 bundles of Mbundumali stems, enough for 33.5 ha, were distributed in Mulanje on the GTZ Integrated Food Security project.

New cassava varieties. The main strategy was the development and testing of new cassava germplasm under different agroecological conditions. The objective was to evaluate and select clones that were tolerant to major cassava pests and diseases, high in root yield and dry matter content, had good adaptation to various agroecological conditions, and acceptable eating qualities (taste and texture).

The evaluation was essentially based on and followed the IITA breeding scheme, starting with the crossing block (where necessary), then seedling nursery (SN), Clonal evaluation (CE), Preliminary yield trial (PYT), Advanced yield trial (AYT), Uniform yield trial (UYT), and on-farm trials. However, the evaluations in the CT and Angola relied mostly on introductions of almost-ready clones from IITA, Nigeria, and other countries within SARRNET. This proved useful in the light of the lack of capacity in some project implementation areas for in-depth detailed breeding. Nonetheless, the efforts bore fruit in advancing some clones to advanced stages of evaluation (UYT and on-farm), and the official release of some clones for farmers to grow in the case of Malawi (LCN8010 and 83350 released in November 2008). Table 4 summarizes the germplasm development activities during the project period in the CT and Angola.

Table 4. Summary of activities for evaluating cassava varieties and new germplasm introduction in the CT and Angola.

	Malawi (central/southern region)	Zambia (Chipata)	Mozambique (Angonia)	Angola
2000/ 2006	• Crossing block established and nearly 17,200 crosses made • Introduced cassava genotypes (259 clones in form of stem cuttings and 326 clones in form of tissue culture) from IITA Nigeria to IITA Malawi for bulking up and distribution to NARS for evaluation and selection in the CT and Angola • Several breeding trials (SN, CE, PYT, AYT, and UYT) were conducted by the NARS to evaluate and select clones for pest and disease tolerance, root yield, and adaptation to various agroecologies • Ten on-farm trials were conducted by the NARS in Ntcheu, Lilongwe, and Balaka districts	• Introduced 192 cassava genotypes (in form of tissue culture) at Mansa Research Institute from IITA Nigeria for CE in Zambia • Ten cassava clones from Mansa introduced and evaluated at Msekera Research Institute, Chipata • Two on-farm trials were planted in Chipata but destroyed by livestock	• Thirty cassava clones introduced and planted at Mtengo Umodzi, Angonia. No data were collected as the clones were severely damaged by frost • Six on-farm trials / demonstrations implemented with other CT consortia partners (ICRAF)	
2006/ 2007	• A total of 5317 crosses was made in the cassava crossing block at Chitedze and resulting seeds, together with other OP seeds, were planted in the SN • Introduced 7050 true botanical seeds from IITA Nigeria for the SN • Established a SN with 19,542 seedlings at Chitedze • Established a CE trial at Chitala with 194 IITA clones from IITA Malawi • Collected, established, and maintained 69 types of local cassava germplasm at Chitedze • One AYT with 6 sites and 1 UYT with 8 sites conducted. • Eight on-farm trials conducted in Lilongwe, Ntcheu, and Dedza by NARS	• Established a CE trial at Msekera with 102 IITA clones introduced through SARRNET • Two on-farm trials/ demonstrations conducted in Chipata. Varieties evaluated were Bangweulu, Chila, Kampolombo, Mweru, and Manyopola (farmer's variety)	• Established a CE trial at Casa Agraria, Angonia, with 156 IITA clones introduced through SARRNET • Established a PYT with 6 clones at Casa Agraria, Angonia • Conducted 8 on-farm trials in Moatze, Angonia, and Tsakama districts. Clones evaluated were Chinyembwe, Segi mesis, and Manyokola (check)	• Maintained 11 local and 2 introduced cassava germplasm at Malange and 28 local and 12 introduced germplasm at Mazozo Research station • Established 1 Uniform yield trial with 12 testing clones at Malange

	Malawi (central/southern region)	Zambia (Chipata)	Mozambique (Angonia)	Angola
2007/ 2008	• A total of 249 out of the 19,542 cassava seedlings in the 2006/2007 SN selected/cloned and planted in a CE trial at Chitala for further evaluation for pests and diseases and preliminary root yield • A total of 30–35 testing clones and 2 checks from the 2006/2007 CE trial planted in PYT and 18 testing clones and 2 checks selected and planted in AYT. The objective was to evaluate the clones for root yield, pest and disease tolerance, and adaptation to various agroecologies. • Two UYTs (I and II), each with 17 testing clones and 2 checks, conducted at various agroecological zones in the country • Eight on-farm trials conducted by NARS	• Thirty-five testing clones and 2 checks (Bangweulu and Manyopola) selected from the 2006/2007 CE trial planted in PYT at Msekera in Chipata	• Thirty-six clones and 1 check selected from the 2006/2007 CE trial planted in PYT at Casa Agraria, Angonia	• A total of 45,000 open-pollinated (OP) botanical cassava seeds were introduced in Angola and planted in a SN to screen for pest and disease resistance • A total of 211 IITA clones from IITA Malawi were introduced and planted in a CE trial in at Malange and Kilombo, November 2007.
2007/ 2008	• Official release of clone LCN8010 (given local name of Phoso) and 83350 (given local name of Mlora) in November 2008 • A total of 63 types of local cassava germplasm from 2007/2007 was maintained at Chitedze			
2008/ 09	• The 259 cassava genotypes introduced in 2006/2007 from IITA Nigeria maintained at Chitedze • A total of 34 clones evaluated for root beta-carotene at Chitedze	• A total of 13 of the 35 clones from the 20072008 PYT at Msekera selected and planted in AYT. The selection was based on superior performance in terms of root yield, pest and disease tolerance, root dry matter content, and taste • Another AYT with 13 testing clones established at Mansa (13 clones) and Golden Valley (10 clones) • Sixteen on-farm trials/ demonstrations established in Mansa, Mwense, Chelenge, and Samfya in Luapula Province to evaluate the promising clones on-farm before release • Established one trial with 13 clones on the evaluation of clones for frost tolerance at Mutanda Research station • Yellow root clones, 99/2987, 01/1224, 01/1380, and 01/1115, evaluated for their agronomic performance and root beta-carotene content at Mansa	• Fourteen clones (5MZ, M98/0068, 97/0162, 99/7558, 93/0266, 98/11081, 4MZ, 97/4763, 00/0203, 96/1708, M98/0068, 3MZ, 93/0151, and 92/00061) selected from the 2007/2008 PYT and planted in 2008/2009 AYT for further evaluation • One trial with 15 clones established in Angonia to evaluate the clones for frost tolerance • A total of 82 clones comprising 16 yellow root (IITA, Ibadan) and 66 high root protein content (CIAT, Cali) introductions evaluated at Umbeluzi and Mocuba Research Stations	• One CE trial with 72 testing clones was established at Malanje and Quilombo, with IITA clones introduced in 2007 • A SN (5,000 seedlings) was established at Chianga but experienced poor germination • A total of 122 IITA cassava clones introduced from IITA/Malawi in 2007 were maintained • Eighteen yellow root cassava clones selected from the IITA introductions in 2007 were planted in a clonal evaluation trial at Malanje and Quilombo

	Malawi (central/southern region)	Zambia (Chipata)	Mozambique (Angonia)	Angola
2009/10	• A total of 22 of the 187 IITA clones at Chitala selected and planted in PYT for further evaluation for root yield, consumer acceptance, and tolerance to pests and diseases • Thirty-four yellow root and 2 white fleshed (checks) clones planted at Chitedzefor further evaluation of root beta-carotene content	• A total of 176 clones were selected and planted in five separate replicated trials of 19, 39, 32, 47 and 39 clones/trial. • Two AYTs at Mansa and Msekera, were harvested; at Msekera 9 clones selected and planted in UYT • One on-farm trial belonging to Mr Aron Bwalya harvested. • Cassava demonstration plots set up in Milenge and Samfya districts using four improved (Tanganyika, Bangweulu, Mweru, and Kampolombo) and one locally available variety (check) to create awareness and improve availability of planting material • Trial on cold/frost tolerance harvested and repeated at Mutanda	• The AYT in Angonia harvested and 11 clones selected and planted in UYT for further evaluation • Trial on cold/frost tolerance planted for time at Mtengo Umodzi, Angonia	• Three CE trials with 250, 346 and 119 clones each maintained at Malange and another with 130 clones at Chianga station. • A total of 217 yellow root and 152 cream pulp clones in a clonal evaluation trial maintained.

Appropriate cultural practices. The strategy was to conduct agronomic trials to identify and evaluate appropriate and ecologically sustainable crop production practices, such as intercropping systems, soil fertility, date of planting, and integrated weed management to enhance root and tuber crop productivity.

From 2006 to 2008, trials were conducted to evaluate ten cassava genotypes (Mbundumali, Sauti, TME 1, TME 7, BA95/070, LCN8010, MK95/054, 83350, I91/0237, and 182/00576) for intercropping suitability with maize (DK 8051) and pigeon pea (ICP9145) in Malawi. All three crops were planted on the same day at the onset of the planting rains in December, cassava at 0.9 m apart (1 plant/station), maize and pigeon pea between cassava stations, (three plants/station). Maize was basal-dressed with 200 kg 23:21:0 + 4S (23% N, 21% P_2O_5, 4% S) and top-dressed with 200 kg Calcium Ammonium Nitrate (26% N). There were no significant ($P \leq 0.05$) differences in maize and pigeon pea yields due to intercropping with cassava. On the other hand, cassava root yields were significantly reduced with intercropping and root yields differed significantly ($P \leq 05$) among genotypes; 83350 was the highest yielding clone in both sole and intercrop, making it the best among the clones evaluated for intercropping with maize and pigeon pea.

On the basis of studies conducted from 2004 to 2006 on storing cassava stems, vertical cassava stem storage was released in Malawi in 2008. Farmers could effectively store cassava stems under well-ventilated shade without affecting their viability and subsequent root yields for up to 3 months for large-sized stems, such as Mbundumali and Mkondezi, and 2 months for small-sized stems, such as Silira and Maunjili. The stem storage technology was suitable for mid-altitude areas (1000–1500 m above sea level) with dry season temperatures of 16–24 ^{0}C and relative humidity of 40 to 90%. The technology could save at least 15,000 bundles of cassava stems, enough to plant 230 ha/year, thereby reducing the shortage of material experienced at planting time. At least 13,000 farmers in Malawi were expected to benefit from this technology once promoted.

In 2008/2009, a trial to evaluate commercially available pre-emergent herbicides for weed control in cassava was also initiated in Malawi. The herbicides under evaluation were Bullet, Harness 90 EC, Codal Gold 412-5 EC, and Metalachlor 960 EC. Preliminary results indicated that herbicides significantly ($P \leq 0.001$) reduced early weed growth by 74.8 to 91.2% at Chitedze and by 53.7 to 97.9% at Chitala. Bullet was a more effective herbicide which resulted in increased root yields (12.3 t ha^{-1} at Chitedze and 18.4 t ha^{-1} at Chitala) and returns (MK238,844.00 ha^{-1} at Chitedze and MK360,779.00 ha^{-1} at Chitala). These results were comparable to or higher than those obtained after hand weeding (root yield of 10.6 t ha^{-1} at Chitedze and 16.3 t ha^{-1} at Chitala

and returns of MK201,438.00 ha^{-1} at Chitedze and MK310,448.00 ha^{-1} at Chitala). They were also comparable to or higher than results after the other treatments (root yield of 2.2–13.1 t ha^{-1} at Chitedze and 1.3–23.6 t ha^{-1} at Chitala and returns of MK44,000.00 ha^{-1} to MK249,078.00 ha^{-1} at Chitedze and MK26,000.00 ha^{-1} to MK465,100.00 ha^{-1} at Chitala). Bullet proved to be a potential alternative to hand/hoe weeding for weed control in cassava, especially where labor was scarce or expensive.

In Zambia, a similar trial was conducted. In addition, hand cultivation, glyphosate, and paraquat post-emergent herbicides were evaluated. Results showed more than 70% reduction in total weed biomass in weeding treatments. Economic evaluation for the experiments showed that the use of paraquat was the least expensive (US $38.00/ha) whereas hand weeding was twice as expensive (US $84.00/ha). Another trial was initiated in Zambia to determine appropriate planting dates for cassava. Results indicated that planting after mid-January led to significant ($P < 0.001$) losses in root yield of up to 26.5% as well as in planting material. This information would assist farmers in Zambia to plant early (not later than mid-January) and avoid/minimize unwarranted losses in root yields.

New product development and processing technologies

The project developed, demonstrated, and disseminated new cassava products to diversify the food basket and reduce food insecurity in the CT. Table 5 outlines the major activities and achievements in new product development in Malawi where most of the activities were undertaken

Table 5, Development of cassava based food and nonfood products in Malawi.

Product	Achievements
Cassava flour, nutritious roots and leaves	• Identified opportunities for use of cassava in food processing, confectionary, timber, packaging, and feed production. Potential pilot sites identified (Kapili, Mthiramanja, Mbawa, and Mpamba) but only Mpamba was set up for processing cassava flour and chips. Bakeries (Alongolele Enterprises, Kachere, and Blue Ribbon) assisted with start-up wrappers for cassava bread. • Analyses of beta-carotene content showed highest levels of carotenoids in clone 01/1380 (8.5 µg/g) and 98/2132 (7.15 µg/g) and lowest levels in white fleshed Mbundumali and DL90/034 (< 0.05 µg/g). • Analysis of fungal and mycotoxin contamination using 88 samples in Malawi showed much lower levels of aflatoxin (0.1 to 2.0 µg/kg) in 30% of the samples. The levels were lower than the world median total aflatoxin maximum tolerable limit (MTL) of 10 µg/kg. In Zambia, analysis of the 22 processed cassava samples collected in April 2009 showed that 7 samples (31.8 %) were contaminated with aflatoxins. Except for one sample with high levels (16.0 µg/kg), the rest had levels of aflatoxins (0.0 to 4.2 µg/kg) far below the world MTL of 10.0 µg/kg (FAO 2004) and hence were safe for human consumption. • Studies showed that pounded cassava leaf vegetables could be stored for up to 30 days in a refrigerator (4 °C) without losing the fresh green color or producing a pungent smell. • Other studies showed that peeled chopped fresh cassava roots treated with Sodium Meta-Bisulphate solution (0.5%) could be stored for up to 10 days at 4 °C without losing quality.
Starch	• Starch content evaluation showed that clones CH92/082 and TME 6 had high starch extraction rates (21.8 to 22.6%). The clones were selected and distributed for on-farm multiplication and demonstration at Masinda in Nkhotakota. • Other studies on starch content for 27 clones showed the highest starch content in parenchyma (27.9%) followed by the inner peel (9%), and then the inner plus outer peel.
Silage	• Studies showed that use of cassava silage as dairy feed increased milk yield by 71%/animal/day. • Studies showed that silage could be kept in plastic bags for up to 4 months without losing quality. • Mechanical chopping and pit ensiling were found to be more effective in reducing the cyanogenic glucosides than manual chopping and bag ensiling.
Feed	• Studies at Bunda College to evaluate the performance of broiler chickens fed on cassava-based rations (0, 10, 15, and 20% cassava) showed that cassava-based diets of up to 20% could be used in broiler production without adversely affecting live weight, dressed weight, dressing percentage, and returns/bird at 7 weeks of age.

Table 6. Summary of postharvest processing technologies available in Malawi.

Technology	Description
Chipper and graters	• Cassava chippers and graters were imported and fabricated in Malawi for distribution and use in pilot processing centers. • Five chippers and 3 graters were fabricated and delivered to pilot centers for processing sweet and bitter cassava. • Two sets of heavy duty cassava graters, for Mozambique and Angola, with an output of 5 t/hr of fresh cassava roots were fabricated by C-to-C Engineering Services • A modified grater increased starch extraction rate from 18 to 22%, enabling farmers to producer 220 kg of starch/t of cassava, up from 180 kg.
Portable leaf chopper	• A portable cassava leaf chopper and prototypes were tested for chopping cassava leaves, tender shoots, and roots for silage making. No results were reported.
Pulverizer	• A fabricated cassava pulverizer yielded 17–20% increase in starch extraction.
Solar drier	• A solar drier with 5% advantage in drying time over sun drying was constructed and further raised room temperature by at least 10 °C. • Two of the modified solar driers were delivered at Masinda starch processing plant in Nkhotakota and the other for drying grated cassava at Mthyoka processing center in Lilongwe. • At Masinda, the solar drier reduced the drying time for starch from 3 days to 1 day, enabling farmers to dry up to 3 t/week of starch as opposed to 500 kg/days.
Cassava peeler	• A fabricated cassava peeler removed 80 to 92% of the cassava peel from uniformly shaped roots and 25 to 60% from irregularly shaped roots. The peeling output (19.7 kg/hr) was slightly higher than that of traditional hand peeling using knives (16.1 kg/hr).

Table 7. Publication of the ROOTS Newsletter.

Year	Issue	Number of copies printed
2003/2004	Vol. 9, No. 1	(No information)
2005/2006	Vol. 10, No. 1	(No information)
20062007	Vol. 10 No, 2	Over 1000 distributed in over 20 countries
2007/2008	Vol. 11, No. 1	Over 1000 distributed in over 20 countries
	Vol. 11, No. 2	Over 1000 distributed in over 20 countries
2008/2009	Vol.12, No. 1	500

To facilitate adoption of new cassava products, labor-saving technologies were introduced, demonstrated, and disseminated to improve the efficiency of the processing activities. As in the case of new product development, activities to develop labor-saving technologies were concentrated in Malawi. Table 6 captures some of the major achievements.

Technology dissemination and information sharing

Technologies that were ready for transfer to potential beneficiaries were disseminated through field days or the print or electronic mass media. The project produced the ROOTS Newsletter (Table 7) as a medium for disseminating research findings on cassava and sweetpotato as well as news of events, technology releases, and transfers, also for activities in other crops besides root and tuber crops.

In collaboration with FAO, the project produced three posters on Cassava seed multiplication, Cassava pests and their control, and Cassava diseases and their control, and distributed over 2000 copies to collaborators and stakeholders.

The copies were printed in English and Chichewa (for farmers in the CT to find them easy to read and understand). A handbook on production, management, protection, and processing was drafted and translated into two main local languages in Mozambique. In Zambia, leaflets, posters, and brochures were produced on integrated production and plant protection management.

IITA/SARRNET participated in the drafting of a Cassava and Sweetpotato Production Handbook, organized by the Ministry of Agriculture and Food Security in Malawi. The IITA/Malawi website was redesigned to include direct links to projects.

Table 8. Summary of training course conducted in the CT and Angola.

Training course	Participants trained			
	Malawi	Mozambique	Zambia	Angola
Cassava production (seed multiplication, pest and disease management, and stem storage)	4513 farmers (2710 men and 1793 women)	443 farmers (276 men and 167 women)	701 farmers (366 men and 335 women)	50 farmers from 6 associations and 700 members
Cassava silage making and use	227 farmers (109 men and 67 women)			
Cassava processing and marketing (processing and utilization of flour, chips, quality, standards, hygiene, and environmental issues)	496 farmers (326 men and 170 women)	16 farmers (11 men and 5 women)		5 women trained in processing and marketing of cassava chips and flour
Total trained	5161	534	1056	

Source: Annual reports for 2003/2004 to 2008/2009.

Capacity building

Capacity building activities focused on imparting new knowledge and skills on production and postharvest processing technologies to farmers, processors, project staff, and collaborators.

Farmers' training

Throughout the project period and across impact sites, several training courses for farmers were conducted to impart knowledge of and skills on cassava production and seed multiplication as well as on processing technologies. A total of 5161 were trained in Malawi, 534 in Mozambique, and 1056 in Zambia on cassava production, cassava seed multiplication, silage making, use of cassava flour for baking, processing of high quality flour, cassava pests and diseases, cassava stem storage, cassava processing and utilization. Some training was done through open/field days on various aspects of cassava production and processing. Table 8 outlines the training courses conducted and the numbers of farmers who attended.

In 2003/2004, 3112 farmers (1880 men, 1234 women) were trained in Malawi. Over 2500 farmers were trained informally on cassava multiplication during seed distribution. Fifty-one farmers from Chimbiya and Bvumbwe bulking groups were trained in cassava silage making and use. A total of 263 farmers (157 men and 116 women) were trained on cassava production and seed multiplication and 73 farmers were trained in cassava processing and utilization.

In Zambia, an agricultural field day was held at Mt Makuru Research Station and a total of 500 people attended, including 355 farmers. Demonstrations were carried out on the use of motorized and manually operated cassava chippers and on the use of various cassava-based recipes, such as those for cakes, biscuits, meat pies, and scones. The number of participants in these activities was not clear.

In Mozambique, four training sessions on cassava processing and utilization were conducted: 2 in Nampula, 1 in Zambezia, and 1 in Umbeluzi. The trainings were conducted in collaboration with Agricultural Directorates, CARE, Save the Children, Conselho Cristao, and SG2000. Some training courses for farmers were conducted by the Institute for Professional Training in marketing and business skills. However, it is not clear how many participants in the training were from the CT part of Mozambique. In Angola, 50 farmers from 6 associations and 700 members were trained in cassava production and marketing in Quenquela. In addition, 5 women were trained in the processing and marketing of cassava chips and flour.

In 2005/2006, a total of 679 farmers (253 in Malawi, 301 in Mozambique, and 125 in Zambia) were trained in production and seed multiplication. One hundred and seventy-six farmers (109 men and 67 women) were also trained in cassava silage making and use. Similar trainings in production and seed multiplication were done in Angola where 20 farmers attended.

In 2006/2007, a total of 184 small to medium-sized[5] bakers (106 men and 78 women) were trained in Malawi on the use of cassava flour for baking scones, donuts, fritters, cakes, and bread. The bakers were linked to the processing centers in Lilongwe and Kasungu for a supply of high quality non-fermented cassava flour. It is, however, not clear whether the bakers sustained the linkages with the processing centers. Forty-four members (37 men and 7 women) of the processing centers and entrepreneurs identified in previous years were trained in quality (hygiene, standards) and environmental issues, the role of the quality standards, machine (grater) services and repairs, machine operation, and in the drying and storing of the processed products.

In 2006/2007, Malawi Entrepreneurs Development Institute (MEDI) in collaboration with SARRNET trained 57 farmers (31 men and 26 women) in preserving cassava planting material in Chigonthi and Ngwangwa Extension Planning Areas (EPAs) in Lilongwe district. A hands-on training on cassava pests and diseases was conducted for farmers (47 men and 43 women) in Angonia (Chindeque), Tsangano (Gimo and Lidoo), and Tsacama districts in Mozambique. A similar course was conducted in Zambia (Chipata and Katete districts) for 157 farmers (94 men and 63 women) and in Malawi for 673 farmers (398 men and 275 women) in Kasungu.

In 2007/2008, a processor and one of the extension staff from Angonia, Mozambique, visited a small-scale processor in Malawi to share experiences on running a cassava processing center. One hundred and twenty farmers were trained in Malawi on cassava processing and utilization. A similar training, but using improved cassava processing methods (grater), was conducted at Chindeque, Mozambique, where 16 farmers and bakers attended. Another training course was conducted on cassava production/seed multiplication for 145 farmers in Malawi, 52 farmers in Mozambique, and 98 farmers in Zambia. Three agricultural field days were held in Chipata to enable farmers to interact and share ideas with researchers, extension workers, and other collaborators. A total of 85 farmers attended. Furthermore, 11 members of the executive committee (6 men and 5 women) of Kafukusi Farmers' Group in Chipata were trained on group dynamics and leadership.

Staff and students' training

Four hundred and fifty-five extension and crop officers were trained on cassava production, seed quality control, certification, and multiplication. In addition, 30–35 participants from NGOs, research, extension, farmers' groups, and seed companies attended training workshops on successful community-based seed production strategies, held in Harare (Zimbabwe), Chipata (Zambia), and Arusha (Tanzania). It is not known how many of the participants were from the CT. Two Research Associates from IITA-Malawi attended a training workshop in South Africa on strategies to enhance the competitiveness of African businesses and expand employment and incomes in rural communities.

The exact number of students trained or supported through the livelihood project was not clear. Discussions with senior members of IITA staff suggested that more than 10 undergraduate students from Bunda College and 1 MSc student from Malawi Polytechnic (both constituent colleges of University of Malawi) and 2 students from the Natural Resources College were attached to IITA/SARRNET between 2004 and 2009. Six students from universities in France were also attached. Two PhD students were co-supervised by members of IITA/SARRNET staff.

Institutional capacity building

The implementation of the project depended heavily on collaboration with and the active participation of different research and development institutions. Some of the collaborators included Plan International Malawi, FAO, CARE International, Save the Children (USA), World Vision, Total Land Care, ICRAF; Bunda College,

[5] Medium-sized bakers are those who use 6 to 12 bags (300 to 600 kg) of wheat flour/day while small-sized bakers are those who use less than 6 bags (300 kg)/day.

large-scale farmers, NARS, FANRPAN, CIP, ICRISAT, Horticulture Network, CNFA, and CIAT/TSBF. In Angola, IITA/SARRNET collaborated with Cooperative League of the United States of America. These organizations benefited through experience in implementing the project as well as from improved technical knowledge through the training of their staff.

Summary of benefits and beneficiaries

A set of 14 indicators was used to indicate whether or not the project achieved success in the planned activities. Table 9 captures the target and actual beneficiaries across the years.

Direct beneficiaries: Rural and vulnerable households

The majority of the direct beneficiaries included farmers and processors who participated in the various training courses, pilot activities, and field days where they obtained valuable knowledge, information, and skills on various aspects of cassava production and processing. Some of the households, farmers, and farmers' groups acquired processing machines for value addition. Households within the neighborhoods where the project activities were implemented benefited indirectly through access to markets by selling cassava to processors and the increased cassava supply. By 2008, a total of 10,843 rural households and 8743 vulnerable households had benefited. These results were beyond the planned targets of 9393 rural households and 7008 vulnerable families.

Direct beneficiaries: Agriculture-related firms

The majority of firms that benefited were from Malawi. These included Universal Industries, Chitipi farms, Rab Processors, RAIPLY, Leopard Matches, C-to-C Engineering, Nzeru Radio Comapany, PIM, Natures Gift farm, Kachere and Blue Ribbon bakeries, Alongelele Enterprise, and Kakuyu Farm. These firms benefited from access to improved varieties, cassava flour, cassava starch, graters, and chippers. A few other firms benefited from Angola, Zambia, and Mozambique, such as Mayana Dairy Farm in Zambia.

Partner organizations and active institutional members

A number of partner organizations participated and benefited from the project including Land-O-Lakes; PLAN Malawi, OSCODE in Zambia, NARS for Malawi, Zambia, and Mozambique, Bunda College of Agriculture and Chancellor College in Malawi, Copperbelt University of Zambia, and Agostinho Neto University in Angola.

Table 9. Summary of the beneficiaries by indicators from 2003/2004 to 2008/2009 in the CT and Angola.

Indicator	Year									
	2004/2005[1]		2005/2006		2006/2007*		2007/08		2008/20.09	
	Target[2]	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual
No of rural households benefited directly from intervention,	2000	2912	3000	4843	4000	7893	9393	10843		
No. of vulnerable households benefited directly from intervention	1500	2890	2000	4533	3000	5808	7008	8743		
No. of agriculture-related firms benefited directly from intervention	8	9	10	12	12	16	18	18	20	21
No. of partner organizations and active institutional members of those organizations	8	10	12	15	14	18	20	20	29	27
No. of male individuals trained	1000	2230	1500	2404	2000	4160	4660	4499	6060	4614
No. of female individuals trained	800	1191	1000	1304	1500	2320	2520	2662	3120	2778
No. of producer organizations, business associations, and CBOs assisted	10	12	15	14	20	17	19	36		
No. of public–private partnerships formed	5	7	10	12	15	19	21	21	23	24
No. of technologies made available for transfer	6	6	7	7	8	12	12	20	21	29
Area under new technologies	50	89	200	146.5	300	265	300	309		
No. of farmers who have adopted new technologies	500	650	1100	1245	1600	3004	3050	2910		
No. of processors who have adopted new technologies	30	30	60	80	100	105				
No. of new technologies or management practices under research							6	10	38	209
No. of new technologies or management practices under field testing							3	7	20	31

[1]Data on indicators for 2003/2004 were not available. Data on the last two indicators were available only for the last two years.
[2]Note that the figures include beneficiaries from Angola. It was not possible to split the figures into specific countries. Also note that the figures sometimes include those who benefited from activities targeting sweetpotatoes as the two crops were reported together on activities undertaken jointly, such as training.
* Figures are cumulative from 2004/2005. Source: IITA/SARRNET/IEHA indicators.

Male and female individuals who received training

More male farmers (4614) were trained than female farmers (2778). However considering the challenges facing women in participating in economic activities, the project should be commended for making significant strides to reach out to that number of women.

Producer organizations, business associations, and CBO

Direct benefits from the project also trickled to 27 producer organizations, business associations, and community-based organizations. Among the beneficiaries were Masinda Cassava Starch Cooperative Society, Mbwandimbwandi Gardens, Alongolele Enterprise, Mwangilira Processing Group, Chiwamba Cassava Production and Processing Association, milk bulking groups, Mthyoka Cassava Processing Center, Chisemphere Cassava Processing Center, Chinangwa-Mbatata Roots and Tubers Association, and Kakuyu Farms in Malawi and Mayana Dairy Farm in Zambia.

Public–private partnerships formed

The success of the project rested on forming partnerships with other stakeholders. A total of 24 partnerships were formed in the CT including Land-O-Lakes, OXFAM, PLAN International, Bunda College, Integrated Food Security Project, Total Land Care (TLC), Alongolele Enterprises, Chancellor College, Nature's Gift Farm, ICRAF, CIP, Kakuyu Farm, MEDI, Mayana Dairy Farm, ICRISAT, NARS, CIAT-TSBNF, CNFA, Universal Industries. In Angola, IITA/SARRNET collaborated with the Cooperative League of the United States of America (CLUSA).

Technologies for transfer

Technology development without dissemination to ultimate users could be a waste of resources. About 29 technologies that were developed were gradually made available for transfer to intended users. These included cassava chippers, graters, leaf choppers, solar driers, pulverizers, improved cassava varieties, high quality cassava flour for bakeries, cassava silage, storage of fresh cassava leaf vegetable, storage of fresh cassava roots, and stem storage, plus a number of agronomic and management practices.

Number of farmers and processors who adopted new technologies

There was a steady increase in the number of farmers and processors adopting new technologies. According to the indicators of the Initiative to End Hunger in Africa (IEHA),out of the 3004 farmers who had adopted new technologies by 2007, 654 were from female-headed households. This constituted about 22% of the total number of farmers who had adopted new cassava varieties. The project had targeted to achieve about 16% of the farmers adopting new varieties. This shows that the project made more significant strides in reaching out to female farmers than intended.

A number of processors had adopted the chippers and graters that were the IITA conceived model and fabricated locally. By 2007, five groups in Malawi (105 farmers) had adopted the grater, where four groups were using it for processing cassava flour while one group was using it for processing cassava starch.

Number of new technologies or management practices under research and field testing

Tracking of these indicators appears to have started in 2007/2008. It shows that the project achieved more than it had targeted in both years. By 2009, there were over 200 technologies and management practices that were under research. Although this sounds as an excellent achievement, it raises questions as to whether the research would be completed, especially if the project was wound up in the same year. It is not clear how such research would be sustained although the results may be needed, nonetheless.

3. Field impact assessment

Study rationale and approach

A field study was undertaken in parts of Malawi, Zambia, and Mozambique in June and July 2010 to complement the literature in assessing the adoption and impacts of the cassava research for development intervention.

A stratified random sample was used to ensure that a representative sample of cassava growers and non-growers was included. First, the impact areas were listed and a random sample was drawn. The selected impact areas included six extension planning areas in Malawi, three camps in Zambia, and six agricultural divisions in Mozambique. A sampling frame was generated for all growers and non-growers in the selected sites from which a random sample was selected. Since the main focus of the study was on cassava growers, it was decided that two-thirds of the sample should be growers. After discussion with IITA staff, it was noted that more activities were conducted in Malawi than in Zambia and Mozambique. Hence, it was decided that half of the sample should be from Malawi and the other half should come equally from Zambia and Mozambique. A total of 617 households were interviewed, consisting of 476 cassava growers and 141 non-growers (representing 22.8% of the total sample). A total of 302 households (253 cassava growers and 49 non-growers) were interviewed in Malawi, 155 households in Zambia (113 cassava growers and 42 non-growers) and 160 households in Mozambique (110 cassava growers and 50 non-growers).

A semi-structured questionnaire was used to collect data on household size, farm characteristics, crop production, technology adoption and use, and marketing. Ten enumerators in each country were identified and trained to administer the questionnaire through personal interviews. During the training, enumerators pre-tested the questionnaire to enhance their understanding and simplify any questions that might have been difficult. In Mozambique, the questionnaires were translated into Chichewa for ease of understanding by both enumerators and respondents. Previous studies (e.g., Kambewa and Mahungu 2007) also translated the questionnaire into Chichewa for Mozambique. Data collection was supervised by senior members of IITA staff. Two data entry clerks entered the data and this took over a month. Data were cleaned by senior IITA staff and the consultant.

4. Survey results

Household and farm characteristics

Demographic characteristics of the sample

The impact areas in the three countries are dominated by Ngoni (45%), Chewa (38.3%), and Tumbuka (10%), and the remaining 6.7% are a mixture of other ethnic groups. However, the language spoken is predominantly Chichewa (also known as Chinyaja). Farming is the main occupation (94%) and the remaining 6% reported business (2.8%), off-farm employment (1.3%), and others (2.9%). The average age for household heads was 42.7 years (ranging from 19 to 84 years). About 13% of the respondents had had no formal education. The average period of formal education was 5.5 years

Table 10. Ownership of farm equipment.

Equipment	Growers		Non-growers		All	
	N	%	N	%	N	%
Hoe	**473**	**99.4**	**136**	**96.5**	**609**	**98.7**
Panga	**313**	**65.8**	**93**	**66.0**	**406**	**65.8**
Plow	23	4.8	13	9.2	36	5.8
Draft animals	25	5.3	17	12.1	42	6.8
Tractor	1	0.2	0	0	1	0.2
Sprayer	35	7.4	13	9.2	48	7.8
Irrigation pump	40	8.4	8	5.7	48	7.8
Wheel barrow	13	2.7	3	2.1	16	2.6
Bicycle	**266**	**56.0**	**78**	**55.3**	**344**	**55.8**
Motorcycle	4	0.8	6	4.3	10	1.6
Axe	73	15.4	19	13.6	92	14.9
Watering can	23	4.8	4	2.8	27	4.4

Table 11. Period of equipment purchase (percentage of households).

Farm equipment	1990–1994		1995–1999		2000–2004		2005–2009	
	Growers	Non- growers	Growers	Non- growers	Growers	Non- growers	Growers	Non- growers
Hoe	0.4	2.4	6.2	6.3	0	0.8	90.9	92.9
Cutlass	3.1	3.1	15.5	10.8	0	0	78.3	89.2
Bicycle	7.8	12.3	18.4	21.2	6.1	3.0	61.5	69.7
Axe	11.9	18.6	10.2	21.1	0	5.3	59.3	73.7

Ownership of farm equipment

Almost all households have at least some farm equipment including hoes, pangas/cutlasses, plows, tractors, sprayers, irrigation pumps, wheelbarrows, cassava processing machines, bicycles, motorcycles, and axes, among others. The most commonly owned items of equipment were hand hoes (98.7%), pangas/cutlasses (65.8%) and bicycles (55.8%) (Table 10). There was no difference in the ownership of the most common farm equipment, hand hoe, cutlass, and bicycle, between growers and non-growers.

Two people, one in Malawi and one in Mozambique, owned cassava graters which had been provided by IITA/ SARRNET for pilot activities. The machines were in good operating condition at the time of the survey. The current value of farm assets was estimated using the straight line depreciation at 10% rate. Cassava growers had farm assets worth US$ 28.45 compared with US$23.86 for non-growers. Both growers and non-growers acquired the implements mostly between 2005 and 2009 (Table 11). Ownership of the equipment as well as the period of acquisition may not be attributed to cassava production.

Main sources of income

Farming was the most important source of income for the majority (89.6%) of the households (Table 12). Nearly the same proportion of growers (89%) and non-growers (91.5%) reported farming as the most important source of income. Own business was a second, most important source of cash income for 43.5% of the non-growers and 37.4% of the growers. Across countries, more male-headed households (83%) had own businesses than female-headed households (8%). Selling agricultural labor was reported to be the third, most important source of cash income for growers (39%) and for non-growers (31%).

Table 12. Important sources of cash income between cassava growers and non-growers.

Source	First source		Second source		Third source	
	Growers	Non- growers	Growers	Non- growers	Growers	Non-growers
Farming (%)	89.1	91.5	11.0	7.6	6.2	2.9
Own business (%)	4.0	2.1	37.4	43.5	17.5	25.7
Selling agricultural labor (%)	1.1	1.4	28.8	31.5	39.2	31.4

Table 13. Ranking the crops in order of importance.

Crop	Percentage who ranked		
	1	2	3
Maize (n[1] = 604)	79.8	12.7	3.1
Cassava (n = 359)	15.9	31.8	19.2
Irish potato (n = 56)	5.4	33.9	21.4
Sweetpotato (n = 179)	1.7	16.8	32.4
Groundnut (n = 342)	2.3	33.3	33.6
Tobacco (n = 130)	15.4	55.4	13.8
Soybean (n =145)	3.4	11.0	28.3
Beans (n = 210)	3.3	31.9	26.2

Table 14. Average land size by type of land (ha).

	Growers	Non-growers	All
Homestead land	0.34	0.21	0.31
Distant upland	1.22	1.14	1.20
Distant wetland	0.33	0.32	0.32
Total	1.89	1.67	1.83

The major crops grown include maize, cassava, Irish potato, sweetpotato, and groundnut. Most households (79.8%) ranked maize as the most important crop (Table 13) and 16% reported cassava as the number one crop. About 32% reported cassava as the second, most important crop. Cassava contributed about 24% of the total income from crop sales.

The main types of livestock owned were chickens (73%), cattle (16 %), goats (39%), and pigs (22%). Male-headed households with more wives owned livestock with the highest value (US$834.3) whereas female-headed households whose husbands were not resident owned livestock valued at US$178 if they had been sold at the time of the survey.

There was no difference between growers and non-growers in cash income from livestock and crops. If growers sold their livestock at the time of the survey they would get US$366 compared to non-growers who would get US$381.62. Similarly, growers, on average, earned US$431 from crop sales compared to US$424.15 for non-growers. Almost the same proportion of cassava growers (47%) and non-growers (48.9%) hired labor, implying that the hiring of labor may not be attributed to cassava production, although cassava is often used as in- kind payment for labor during hungry seasons.

Land holding sizes

The average land holding size across the households was 1.8 ha. Farmers in Malawi owned, on average, 1.6 ha compared to 2 ha in Zambia and Mozambique. Cassava growers owned marginally ($P < 0.10$) more land (1.89 ha) than non-growers (1.67 ha), (Table 14). Most of the land for both cassava growers (1.22 ha) and non-growers (1.14 ha) was in the distant upland. Customary tenure was the most common system, where farmers had the right to use but did not own the land. However, inheritance was the common mechanism for acquiring land. For example, 47% of the farmers reported that they had inherited their homestead land, 81.4% inherited their distant upland, and 69.2% inherited their distant wetland.

Table 15. Adoption of cassava cropping systems (percentage of households, n = 76).

Cropping system	Practice		Do not practice	
	No.	%	No.	%
Mono-cropping	373	60.5	244	39.5
Intercropping	61	9.9	556	90.1
Mixed cropping	31	5.0	586	95.0
Relay cropping	8	1.3	609	98.7

Cassava production

Farmers who did not grow cassava reported a lack of planting materials (42.3%), land shortage (25%), labor shortage (12.5%), and a lack of interest (10.6%) as the main reasons. Other reasons included theft, poor market access, and sickness. Of the 476 growers, 8.2% started to grow cassava before 1990; 18.2% between 1990 and 1999; 68.9% between 2000 and 2009; and of this last group 53.4% between 2004 and 2009. Evidently the number of farmers growing cassava rapidly increased from Phase II to the time of the survey. The predominant cassava varieties grown included Mbundumali/Manyokola (81.3%). Other varieties included Mbawala, Sauti (improved), Thipula, Guguza, Mkhalatsonga, Bitilisi, Mgwalangwa, and Abitisumani in Malawi; Chinyembwe and 41[6] in Mozambique; and Mweru, Bangweulu, and Chila (all improved) and Kampolombo in Zambia[7].

About 71.7% of the cassava growers had continued to grow the crop since they started. The other 28.3% had stopped growing cassava due to theft, commitment to other cash crops, because animals destroyed the crop whilst in the field, poor markets, and labor constraints. About 14.3% stopped growing some varieties, such as Manyokola, Sauti, 41, and Gomani, due to lack of planting materials and land shortage. Between 2000 and 2009, 13% of the cassava growers stopped growing some of the varieties

Cropping systems for cassava production

Farmers were asked to indicate the cropping systems they used for cassava, among mono-cropping, intercropping, mixed cropping, and relay cropping. Mono-cropping was the most common farming system practiced by 60.5% of the cassava growers, followed by intercropping 9.9%, mixed cropping 5%, and relay cropping 1.3% (Table 15).

The results imply that about 23% of the farmers used other farming systems. In Malawi, 67% of the growers reported they used mono-cropping compared with 60% in Zambia and 48% in Mozambique. Few farmers—12.9% in Malawi, 5.8% in Zambia, and 8% in Mozambique— practiced intercropping. Mixed cropping was practiced by 11.9% of the farmers in Mozambique. Farmers used intercropping or mixed cropping with maize or pigeon pea to take advantage of labor, land, and the fertilizer applied to maize. Although intercropping was one of the technologies that IITA/SARRNET tested, this was basically limited to research stations.

Land allocated to cassava

The area under cassava was considered relative to the area under maize. Twice as much land was allocated to maize (0.8 ha) than to cassava (0.42 ha). Households allocated more land to maize (0.7 ha) in Malawi and Zambia (0.9 ha) than to cassava. In Mozambique, slightly more land (1.29 ha) was allocated to cassava than to maize (1.25 ha), (Table 16).

[6]Note that 41 is a name of the variety reported in Mozambique.

[7]Additional varieties reported included Kawalika, Mayela, Mbabala, Khunga, Mwaya, Mayawa, Manyokola/mbundumali, Gomani, and Nkhwazi. Note that Mbundumali is also known as Manyokola in central and southern Malawi and as Mwaya in Nkhotakota. In some areas, farmers also refer to Manyokola as 41.

Table 16. Average land holding sizes.

	Malawi	Zambia	Mozambique	All
Total land holding size (ha)	1.6	2	2	1.8
Area allocated to maize (ha)	0.7	0.9	1.25[9]	0.8
Area allocated to cassava (ha)	0.5	0.3	1.3	0.4

[9] Note that the total land owned might not necessarily equal summation of land allocated to individual crops because of double estimation of land under individual crops in mixed and intercropping systems.

Table 17. Main objective for growing maize and cassava.

	Malawi	Zambia	Mozambique	All
Grow maize primarily for food security (n = 617)	53.3	31.6	59.4	49.4
Percentage of maize sold (n = 617)	13.4	26.2	12.9	16.0
Grow cassava primarily for food security (n = 476)	14.2	20.0	6.9	13.8
Percentage of cassava sold (n = 476)	49.8	31.4	50.1	43.7

Table 18. Change in land allocated to cassava between 2007/2008 and 2008/2009 seasons.

Year	Average area (ha) under		
	Local varieties	Improved	Mixed
2007/2008	0.3532	0.1680	0.0605
2008/2009	0.3978	0.2068	0.0681
Change (%)	0.0446 (12.6%)	0.0388 (23.1%)	0.0076 (12.6%)
Year	Average production (t)		
	Local varieties	Improved	Mixed
2007/2008	353.27	185.27	39.85
2008/2009	494.53	338.11	48.26
Change (%)	141.26 (39.99%)	152.84 (82.5%)	8.41 (21.1%)

These results differed from previous studies (Kambewa and Mahungu 2007) that reported that farmers in Malawi allocated more land (0.89 ha) to cassava, 0.75 ha in Mozambique and 0.54 ha in Zambia. The decrease could be attributed to an inadequate supply of planting material that led to some farmers not being able to plant more cassava. In Malawi, it could also be due to the Government subsidy for maize that might have made some farmers change over some land use from cassava to maize production.

About 45.8% of the households grew cassava and 43.6% grew maize for food and to sell. Farmers sold less (16%) of the maize they produced than cassava (43.7%). In Malawi, 53% of the households grew maize primarily for food security compared with 31% in Zambia and 59.4% in Mozambique (Table 17).

Farm households tended to sell any commodity as long as they had surplus production or faced livelihood stresses. Only about 14% of households in Malawi, 20% in Zambia, and 6.9% in Mozambique reported that they grew cassava primarily for food security. With increasing commercialization of cassava production, more households grew cassava for sale. In the absence of comparative baseline data, however, it cannot be speculated as to whether these figures represented an increase or a drop.

Changes in area under cassava and cassava production

Out of the cassava growers, 25.6% (n = 123) reported an increased area under cassava; 58.9% (n = 281) reported no change, and 15% (n = 71) reported a reduced area under cassava. Cassava production also increased over the 2 years prior to the survey. Table 18 presents changes in area and production. The area under local cassava varieties remained higher than the area under improved and mixed varieties combined. Nonetheless, the area under improved varieties increased more (23%) than the area under local varieties (12.6%) and mixed varieties (12.56%).

The area under improved varieties increased more than the 13.9% achieved in SARRNET Phase II (Mahungu et al. 2004). The production of local varieties increased by 40% while that of improved varieties increased by 82.5%. Production in mixed production systems showed the lowest increase (21%). The production of local

Table 19. Reasons for increase/decrease in area under cassava (percentage of households).

Reason for increase (n = 123)	Freq.	%*
Good market	39	16.2
Improved food security	43	17.9
Availability of materials	8	3.3
Just started	5	2.1
Does not need fertilizer	3	1.2
Poor land	5	2.1
Increase in family	4	1.7
Lack of rainfall	2	0.8
Reasons for decrease (n = 71)		
Stopped growing cassava	11	4.6
Lack of market	15	6.2
Lack of land	37	15.4
Lack of storage	7	2.9
Lack of labor	24	10.0
Theft	6	2.5
Lack of planting materials	17	7.1
Concentrated on other crops	12	5.0
Destruction by wild animals	2	.8

*Note that proportions do not add up to 100% due to multiple responses and also because not all respondents gave reasons.

Table 20. Sources of cassava planting material.

Source of planting materials	Malawi	Zambia	Mozambique	All
Fellow farmers	20.4	24.5	**62.8**	44.0
Parents/relatives	13.0	3.8	17.0	13.0
SARRNET /NARS	**53.7**	**52.8**	5.3	27.5
Government extension workers	7.6	0.9	6.4	5.6
NGO/collaborators	5.6	16.9	8.4	9.9

varieties may have increased due to the improved management practices that were promoted (Rusike et al. 2010). Table 19 captures the reasons for the changes in land under cassava.

Increased access to good markets and improved food security were the main reasons given by households who reported that land under cassava had increased. Shortages of labor, land, and planting material, and lack of markets were reported as factors contributing to a decreasing area of land under cassava.

Sources of cassava planting materials

Seed system development and distribution of seeds was one of the core activities of the project. The project engaged a number of partners, especially NGOs and research institutions, to multiply and distribute seeds through their food security programs. Some seeds were distributed on a “pass-on” strategy, where farmers who got seeds were expected to give a similar amount to other farmers when they harvested. This might explain the high proportion (44%) of farmers who obtained seeds from fellow farmers (Table 20).

In Mozambique, 62.8% of farmers reported that they sourced seeds from fellow farmers compared with 20% in Malawi and 24.5% in Zambia. IITA/SARRNET was the predominant source of seeds in Malawi (53.7% of farmers) and in Zambia (52.8% of farmers).

The presence and capacity of IITA/SARRNET in Malawi might have contributed to this. IITA/SARRNET directly distributed 15 000 cassava stems from Malawi to Zambia. In other countries, the project relied on NARS and other collaborators and this might not have been so effective in Mozambique. Farmers who got the seeds from fellow farmers could be secondary beneficiaries of SARRNET seeds, following the pass-on strategy that was being implemented.

The NGOs and collaborators involved in seed distribution included Total Land Care, ICRISAT, Plan Malawi, and World Vision International. Altogether, 24.6% of farmers reported having given planting material to other farmers; 12% sold seeds to other farmers. More farmers in Malawi (59%) gave seeds to other farmers compared with farmers in Zambia (40.6%) and Mozambique (38%) on the basis of the pass-on strategy. Less than 2% of farmers, especially in Mozambique, reported that they bought the seeds.

Pest and disease management

A number of pests were reported to have affected cassava production. The most common included cassava mosaic disease (CMD) which was reported by 75.9% of the farmers in Malawi, 51.4% in Mozambique, and 21.1% in Zambia (Table 21).

Rodents were the second most common pest in Mozambique (24.3%). Termites were the second most common in Zambia (23%). Rodents eat up the cassava roots whilst in the field. Although the list of pests and diseases may be long, only 33% of respondents (39% in Malawi, 20.6% in Zambia, and 34.4% in Mozambique) reported that they were aware of the major pests and diseases affecting cassava production.

The majority of farmers (50%) destroyed the affected plants while 43% did not do anything (Table 22). About 64.7% of farmers in Zambia and 51.5% in Mozambique did not do anything to control pests and disease. It could be that the loss in production due to the pests and diseases did not warrant the cost of taking control measures. None of the farmers reported using improved varieties as a measure for controlling pests and diseases.

Benefits from cassava production

Farmers listed a number of benefits from cassava production (Table 23). The most important benefit reported by the majority of farmers (50.4%) was improved food availability, implying that they grew adequate food to last for the whole season. Other benefits included buying farm inputs (8%), groceries (8%), and household furniture (4.6%), or a combination of these.

Table 21. Proportion of households with experience of pests and diseases.

Pest and disease	Malawi	Zambia	Mozambique	Total
Kangande	5.0	3.8	0.0	3.3
Khate (cassava mosaic)	**75.9**	**21.1**	**51.4**	56.9
Whiteflies	1.7	0.0	0.0	0.8
Green borers	0.8	5.8	0.0	1.6
Bacterial blight	0.0	0.0	1.4	0.4
Aphids	2.5	1.9	10.8	4.9
Mealybugs	0.8	9.6	1.4	2.8
Green mites	7.5	13.5	0.0	6.5
Rodents	2.5	5.8	**24.3**	9.8
Termites	0.8	**23.1**	9.5	8.1
Wild animals	1.7	1.9	1.4	1.6
Cassava scale	0.8	5.8	0.0	1.6
Cassava brown streak	0.0	1.9	0.0	0.4

Table 22. Management of cassava diseases (n = 476).

	Malawi	Zambia	Mozambique	All
Spraying	4.2	13.7	6.1	6.8
Destroying diseased plants	66.4	21.6	42.4	50.0
Do nothing	29.4	64.7	51.5	43.2

Table 23. Benefits from cassava production.

Benefits of cassava	Frequency	Percentage
Improved food availability/security	240	50.4
Bought farm inputs	38	8.0
Bought groceries	39	8.2
Paid school fees	6	1.3
Built a house	7	1.5
Bought furniture	22	4.6
Bought groceries and farm inputs	24	5.0
Bought farm inputs and purchased furniture	27	5.7
Bought farm inputs and paid school fees	3	0.6

Table 24. Coping mechanisms when households ran out of staple food (maize).

Coping mechanism	Cassava growers (n = 476)	Non-growers (n =141)	All (n = 617)
Buy food	23.8	31.8	25.6
Sell agricultural labor	12.2	20.9	14.2
Reduce meals	0.7	3.9	1.4

Increased cassava production and commercialization (through improved access to markets) would have increased household welfare (adequate food, household facilities). The importance of cassava production for food security was more evident when cassava growers were compared with non-growers. More growers (60%) reported that they produced adequate food for the whole year than non-growers (46.7%). The majority of cassava growers (67%) and non-growers (76%) who ran out of staple food did so between December and February. Previous studies also found that more cassava growers reported being food secure than non-growers. In Malawi, Jumbo et al. (2007) reported that 82% of cassava growers were food secure compared with 22% of non-growers.

When households ran out of staple food, they bought alternative foods, sold agricultural labor, or reduced meals (Table 24). Fewer growers (23.8%) bought food compared with non-growers (31.8%). Others ate wild foods or relied on assistance from relatives.

More non-growers than cassava growers bought food, sold agricultural labor, and reduced meals to cope with a food deficit. Both cassava growers (28%) and non-growers (36%) bought maize grain. Only 4.4% of cassava growers reported buying maize flour compared with 7.8% of non-growers. Even fewer reported buying cassava flour, maize bran, and fresh cassava. Only 3% of non-growers bought cassava flour, confirming that cassava remained a food that was not popular in non-traditional cassava growing areas as long as there was a maize supply. Previous studies (e.g., Jumbo et al. 2007) reported that more than 50% of farmers bought cassava during food deficit periods. The difference could be attributed to the fact that production had improved, for example, in Malawi, and maize might have become cheaper than cassava.

Preferred cassava characteristics

Households were asked to mention the production and market characteristics that influenced their decision to adopt a cassava variety. Table 25 shows the four important factors which were taste, root yield, dry matter, and maturity. Over half (54.7%) of the cassava growers ranked taste as the first and most important factor to consider, followed by root yield (38%), and period of maturity (37%). Slightly over 30% of the growers ranked root yield, dry matter, and period to maturity as the second most important factor to consider when adopting a variety. The third most important factor was dry matter content (29.9% of the households) and root yield (27%).

Table 25. Preferred characteristics influencing the adoption of cassava varieties.

Characteristics	Percentage of households		
	1st important	2nd important	3rd important
Taste	54.7	22.8	15.9
Root yield	38.3	33.0	27.2
Dry matter	9.7	31.8	29.9
Period to maturity	37.0	31.9	13.6

Table 26. Major problems about cassava production (n = 314).

Problem	Households reported	Percentage
Lack of reliable markets	55	17.5
Theft	29	9.2
Pests and diseases	61	19.4
Destruction by animals/livestock	27	8.6
Lack of planting materials	33	10.5
Lack of reliable markets and diseases	25	8.0
Lack of reliable markets and theft	13	4.1
Theft and diseases/pests	48	15.3
Lack of technical knowledge	13	4.1
Destruction by animals and lack of planting materials	10	3.2

Table 27. Awareness of cassava management practices (percentage of households).

Practice	Malawi	Zambia	Mozambique	All	Percentage learnt from SARRNET			
					Malawi	ZA	MZ	ALL
Seed selection	70.4	51.6	58.8	62.7	4.4	42.5	27.5	18.9
Planting time	70.4	48.4	55.6	61.0	3.6	37.2	24.8	16.5
Plant spacing	70.8	51.0	56.9	62.2	4.0	42.5	30.0	19.2
Weeding	70.8	45.2	60.6	61.7	3.2	35.4	25.9	16.1
Pest/disease control	39.2	20.6	34.4	33.3	2.4	29.2	20.9	13.1

Main problems with cassava production

Thirty-four percent of the cassava growers reported no major problems with cassava growing. The others reported a number of problems including lack of reliable markets, pests and diseases, theft, destruction by livestock, lack of seeds, and lack of knowledge (Table 26). A total of 19.4% of households reported pests and diseases as the major problem and 17.5% reported a lack of reliable markets. Fifteen percent reported a combination of theft and pests and diseases as the major problem for cassava production.

Capacity building, awareness, and knowledge

Capacity building was another important activity of the project. Besides multiplying and distributing seeds and providing processing machines in pilot sites, the project conducted several farmers' training courses to impart knowledge and skills on the various aspects of cassava production and value addition. Altogether, 39.4% of the cassava growers had received training on various aspects of cassava production and processing. Most of those who received training (27.9%) reported that it was provided by IITA/SARRNET. About 4.3% were trained between 1983 and 1999; 9.5% were trained between 2000 and 2003; 82.5% were trained between 2004 and 2009 during the implementation of the project under study. Other institutions that provided training on cassava production and processing included World Vision, FAO, TLC, ICRISAT, Government, Plan Malawi, MEDI, and government institutions (DARS, Extension) all of which collaborated in the project. The results of the surveys confirm the annual reports, that more capacity was built from 2003/2004 to 2008/2009.

Knowledge and adoption of management and improved varieties

The level of awareness among households about various aspects of cassava production, such as seed selection, planting time, plant spacing, and weeding time was generally good (over 60%), (Table 27).

Most cassava growers were aware of the good management practices that had been promoted. About 70% of farmers in Malawi were aware of how they should select good seeds, when they should plant, at what spacing, and when they should weed their cassava field. A slightly lower proportion in Zambia and Mozambique was aware of good management practices.

Awareness of pests and diseases was relatively low at 33.3% of the cassava growers. Slightly more cassava growers (39%) in Malawi were aware of the major diseases and pests compared with 20% in Zambia and 34% in Mozambique. The common source of information about good management practices was IITA/SARRNET. In Zambia, 42.5% of the cassava growers obtained information about seed selection and plant spacing from IITA/SARRNET. In Mozambique, 30% of the cassava growers obtained information on plant spacing from IITA/SARRNET. Other sources of information were NGOs and government extension workers. In Malawi, IITA/SARRNET worked with a number of government extension workers, NARS, and NGOs who also disseminated information about management practices.

Knowledge and adoption of improved varieties in Malawi

Farmers in Malawi were asked if they were aware of any of the improved varieties Siliria, Sauti, Yizaso, Mlola, and Phoso, that had been released in Phase II of SARRNET. The level of awareness was very low (Table 28).

Out of the 253 cassava growers, only 46 households (18%) were aware of Silira; 51 (20%) were aware of Sauti, and fewer than 20 households (< 10%) had ever heard of Yizaso, Mlola, and Phoso. Households that were aware of the improved varieties were further asked about where they had learnt about the improved varieties. Table 29 captures the responses.

NGOs were the main source of information about Silira (13 households). SARRNET was the only source of information about Sauti. In addition, households were asked when they first used the improved varieties and if they had planted the varieties in the 2009/2010 season. Table 30 captures the distribution of farmers by year when they first used the varieties.

Table 28: Knowledge and use of improved varieties in Malawi (No. of households) (n = 253).

Characteristic	Silira	Sauti	Yizaso	Mlola	Phozo
Ever heard of variety?	46	51	18	11	11
Know about variety?	20	26	7	4	3
Ever used the variety?	8	9	2	1	2

Table 29. Source of information about improved varieties in Malawi (No. of households).

Source of information	Silira	Sauti	Yizaso	Mlola	Phoso
Government institutions	6	6	2	2	2
NGOs	**13**	8	3	1	0
Other farmers	2	8	1	1	0
SARRNET	0	9	0	0	0
Others	3	3	2	1	3

Table 30: Period when households first used improved varieties in Malawi (No. of households).

Year	Silira	Sauti	Yizaso	Mlola	Phoso
1972Í–1999	2	0	2		2
2000–2004	2	1			
2005–2009	4	4		1	
Planted in 2009/2010	5	1	2	0	2

Table 31. Reasons for using or not using improved varieties in Malawi (No. of households).

Reasons for not using	Silira	Sauti	Yizaso	Mlola	Phoso
Lack of planting materials	21	19	18	17	18
Unprofitable	1	0			
Late maturity	3	4	2	2	2
Damage (by pest, theft, or diseases)	1	1			

Table 32. Knowledge and use of improved varieties in Mozambique (No. of households; n = 110).

Characteristic	Manyokola	Chinyembwe	Nikwa
Ever heard of variety?	87	5	4
Have knowledge of variety?	85	5	4
Ever used the variety?	80	2	1

Table 33. Source of information about improved varieties (No. of households; n = 110.

Source of information	Manyokola	Chinyembwe	Nikwa
Government institutions	10	1	
NGOs	10		
Other farmers	27	1	
Agro-dealers	1		
SARRNET	35	3	4
Other sources	3	1	1

When farmers were asked why they had used or not used the varieties, the lack of planting material was their most common reason for not using the varieties (Table 31). Only two households reported that they used Yizaso because of good taste. Two households reported that Silira was high yielding and marketable. Four households reported the same about Sauti and two also reported the same reasons for using Phoso. The five varieties are bitter and probably suitable only for the traditional cassava areas, such as Nkhata Bay and Mulanje. Lack of awareness about these varieties in the non-traditional cassava areas (where the survey was done) reflected the unpopularity of the bitter varieties, as farmers in these areas preferred sweet varieties for sale and not for food security.

Knowledge and adoption of improved varieties in Mozambique

Farmers in Mozambique were similarly asked if they were aware of the improved varieties released in that country, Manyokola, Chinyembwe, and Nikwa. Table 32 presents the results. Eighty-seven households (79.1%) were aware of Manyokola but only five households were aware of Chinyembwe, and four were aware of Nikwa.

Manyokola was the variety most known and used in Mozambique. Eighty-five cassava growers had some knowledge of the variety and 80 had used it. SARRNET and fellow farmers seemed to be the common sources of information about Manyokola in Mozambique (Table 33).

When asked to indicate when they first used the improved varieties, 59 households reported that they had first used Manyokola between 2005 and 2009 (Table 34). Surprisingly, none had planted the varieties in the 2009/2010 season when only one household reported a lack of planting materials as a major problem.

Table 34. Period when households first used improved varieties in Mozambique (No. of households).

Year	Manyokola	Chinyembwe	Nikwa
1972–1999	8		
2000–2004	11		
2005–2009	59	2	1
2010	2		
Planted in 2009/2010	0	0	1

Table 35: Knowledge and use of improved varieties in Zambia (percentage of households; n = 113).

Issue	Manyokola	Bangweru	Chila	Mweru	Tanganyika	Bitsumani	Kampolombo
Ever heard of variety?	95	37	21	19	8	8	1
Know about the variety?	66	23	11	7	4	1	0
Ever used the variety?	52	11	5	4	2	0	0

Table 36. Source of information about improved varieties in Zambia (No. of households).

Source	Manyokola	Bangweru	Chila	Mweru	Tanganyika	Bitsumani
Government institutions	3				1	
NGOs	4					
Farmers	24	1			1	1
SARRNET	35	5	1	1		
Others	1					

Table 37. Period when households first used the improved varieties in Zambia (No. of households).

Year	Manyokola	Bangweru	Chila	Mweru
1972–1999		1		
2000–2004	4			
2005–2009	83	13	7	3
Planted in 2009/2010	65	4	3	1

Knowledge and use of improved technologies in Zambia

Farmers in Zambia were asked if they were aware of the improved varieties, Manyokola, Bangweru, Chila, Mweru, Tanganyika, Bitsumani, and Kampolombo,that were released in the country. The level of awareness was high for Manyokola and low for the rest (Table 35). Out of 113 cassava growers interviewed in Zambia, 95 (84%) had heard of Manyokola; 37 (32.7%) of Bangweru. Twenty-one growers had heard of Chila. Fewer than 20 growers were aware of each of the other varieties.

Out of the cassava growers who had heard of the varieties, 66 had some knowledge and 52 had used Manyokola. Twenty-three growers had knowledge of Bangweru and 11 had used it. Eleven growers had knowledge of Chila. None had used Bitsumani and Kampolombo. Households that had heard of the improved varieties were further asked the source of their information. Table 36 captures the responses.

SARRNET and other farmers were the main source of information about Manyokola. Other farmers could hardly tell how they got the information about the varieties. Growers were also asked when they first used the improved varieties and if they planted them in the 2009/2010 season (Table 37).

Relatively more farmers started to grow Manyokola between 2005 and 2009. A reasonable number also planted in the 2009/2010 season. None of the growers reported that they had ever grown Tanganyika, Bitsumani, and Kampolombo, although these varieties are sweet.

Table 38. Level of awareness about the processing technologies (percentage of households, n = 476).

Awareness about	Malawi	Zambia	Mozambique	All
Grater	23.5	14.8	73.1	34.2
Chipper	10	12.9	6.3	9.7
Press	8.9	11.6	26.3	14.1
Solar drier	7.0	14.2	32.5	15.4
Cassava silage	13.9	13.5	6.3	11.8
Cassava starch	11.9	1.3	2.5	6.8

Table 39. Mode of transport to the market.

	Percentage of households who ranked		
Mode of transport	1	2	3
Foot (n^3 = 538)	72.9	19.3	7.6
Bicycle (n = 489)	34.2	60.9	4.9
Car (n = 135)	20	34.8	45.2
Oxcart (n = 121)	21.5	21.5	57

Of the seven varieties in the survey in Zambia, Bangweru and Chila are bitter while the others are sweet varieties. Mweru, Chila, Tanganyika, and Kampolombo were bred in 2000 by the Root and Tuber Crops Improvement Program. The period had been long enough for a higher adoption rate to be expected than the one that was portrayed. Lack of promotion after the varieties were released might have been the reason.

Awareness of cassava processing technologies

One of the activities the project promoted was value addition to diversify the utilization of cassava in the food and non-food industries. A number of processing machines were distributed to pilot sites. Knowledge about these technologies and their use was expected to spread around the impact sites. Table 38 captures the level of awareness about the processing technologies that were promoted among farmers. Few farmers were aware of the cassava processing machines in all countries. The technology commonly known was the grater (34%). More farmers in Mozambique (73%) were aware of the grater than in Zambia (14.8%) and Malawi (23.5%).

Even fewer farmers reported that they had used the machines. This was due to the high cost which limited access to them. These processing machines were distributed to selected pilot sites and individuals for pilot activities. It might not be surprising, therefore, that not many farmers were aware of them or had used them. The fact that a few knew about them was already an indication that some progress had been made to generate initial awareness

Marketing

The project sought to promote market access for farmers through linking them to the markets or enabling them to improve the quality of their products or by developing new products for specific markets. A number of indicators for market access were captured, including distance to the nearest market and form in which cassava was sold.

Distance and transport to nearest market

The basic factor for access to market considered was distance to the nearest market. On average, the nearest market or trading center was 4.8 km away and the time it took farmers to reach it was generally about 1 hour.. The most common means of transport to the main market were on foot, by bicycle, oxcart, and car (Table 39).

The majority (72.9%) of the respondents walked to the market and this was their most important mode of transport. The second and third most important modes of transport were bicycle (60.9%) and oxcart (57%). Other modes of transport included boats (reported by 8 people) and motorcycles (reported by 22 people).

Consumption and utilization of cassava

Farmers were asked to indicate the form in which they sold cassava (Table 40). Altogether, 52% of the farmers sold fresh cassava (57% in Malawi, 45.8% in Zambia, and 48.8% in Mozambique). Few households in all the countries sold cassava as dried chips, flour, and stems. Farmers mostly sold cassava at the farm-gate to traders who took it to the markets. Distance to the nearest markets and the bulkiness of the fresh cassava compelled farmers to sell at the farm-gate to reduce transport costs. They also minimized losses due to the perishable nature of cassava in the event that they failed to sell.

On average, farmers realized US$100/year from cassava sales. Farmers in Mozambique realized a relatively high income (US$189/year, followed by Zambia (US$155), and then Malawi (US$ 120).

Respondents indicated how they commonly consumed cassava (Table 41). The majority of farmers (96%) consumed boiled cassava or chewed fresh roots (79%) and used cassava leaves as vegetables (76%). Slightly more cassava growers consumed pure cassava *nsima* (31.9%) than mixed cassava *nsima* (38.7%) compared with non-growers.

When asked if their consumption of cassava had changed, more non-growers 33.9% reported an increased consumption of cassava than cassava growers (24.2%). Almost the same proportion of growers (45.3%) and non-growers (47.3%) reported no change in their consumption of cassava.

Sources of information

Farmers obtained information about farming in general from a number of sources. The common sources were farmers' clubs, extension agents, fellow farmers, and the mass media, such as radio. Table 42 shows the proportion of farmers who belonged to farmers' organizations, visited extension agents, or were visited by them.

Table 40. Households who sold different form of cassava products (percentage of households).

Form of cassava	Malawi	Zambia	Mozambique	All
Fresh roots	57	45.8	48.8	52.0
Dried chips	2.6	1.3	8.8	3.9
Cassava flour	7.6	2.6	2.5	5.0
Cassava stems	11.3	1.9	11.9	9.1

Table 41. Households who utilized cassava in different form (percentage of households, n = 617).

Form of cassava	Percentage of cassava growers (n = 476)	Percentage of non- growers (n =141)	All
Boiled cassava	95	97.3	96
Pure cassava *nsima*	31.9	24.1	30.1
Mixed cassava/maize *nsima*	38.7	22	34.8
Cassava leaves	79.2	66.0	76.2
Chewed fresh roots	80.5	75.2	79.3

Table 42. Sources of information for cassava growers and non-growers (n = 617).

	Percentage of cassava growers	Percentage of non-growers	All
Belonged to farmers' organization/club	46.4	40.1	45.0
Visited extension agent	37.7	27.5	35.4
Visited by extension agent	45.7	35.8	43.4
Other sources of information			
- Radio	55.2	45.9	48.1
- Fellow farmers	29.4	26.0	28.6

Altogether, 45% of the farmers belonged to farmers' clubs which mainly promoted agricultural production, improved food security, distributed seeds through the pass-on program, shared market information, and helped farmers to find markets and fertilizer on credit, facilitated access to subsidized inputs, and taught improved farming methods. Teaching was the most common function reported by 11%. Thirty-five percent visited extension agents and 43% were visited by extension agents within one year before the survey. Slightly more cassava growers (46%) belonged to farmers' organizations than non-growers (40%). Similarly, relatively more cassava growers obtained information through the radio (55%) and fellow farmers (29%) than non–growers: 45.9% of them obtained information through the radio, and 26% from fellow farmers. .

5. Conclusions and implications for future strategy

The objective of this study was to assess the impact of the cassava component of the project *Improving rural livelihoods in southern Africa* implemented between 2004 and 2009 in the CT. The major challenge for the analysis has been the lack of baseline data against which to determine changes in the outcomes. Nonetheless, a number of positive contributions can be acknowledged without ignoring the challenges that may have limited the achievements.

Project success

Number of beneficiaries

The primary success of the project was the sustained increase in the number of beneficiaries reached. Achievements were close to or above target. The project relied on partners who had their own core activities and were also answerable to their own programs,. Consequently, monitoring their activities against the project targets was more challenging for the Coordination Office.

Project approach

Primarily the project focused on market-led technology development and dissemination through (1) the introduction, adaptation, demonstration, and dissemination of cassava production and processing technologies, and (2) the development and promotion of cassava-based food and nonfood products targeting different market segments. The combined approach to promote cassava production and support utilization was most appropriate, considering the interdependencies of the production and marketing sectors. The commercialization of the cassava sector cannot take off if either the production or the marketing sector is not adequately supported.

Synergy

The project built on existing and ongoing activities with which it blended well. The existing expertise and intellectual resources were crucial in the implementation of the project. Similarly, the unfinished activities may be carried over into subsequent project initiatives with relative ease. The involvement and formation of partnerships was a critical mass for the implementation of the project, given its wide geographical coverage and range of activities. The partnerships formed viable nodes for sustainable and future collaboration in similar efforts to fight poverty and hunger in the CT through the promotion of roots and tubers.

Awareness

The level of awareness of the role of cassava in the economic development of southern Africa and the CT in particular was enhanced. As a result, interest and investment in the cassava sector by both large and small-scale investors increased. The new varieties, value-adding technologies, and new products (e.g., starch, flour, feed) made known to potential users could not be ignored. In Malawi, large farms in cassava production emerged during the implementation of the project under review. The use of cassava products by industrial companies was attributed to the activities of IITA/SARRNET through the current project.

Livelihood benefits

Although not much livelihood gain was demonstrated by this study, more cassava growers than non-growers had adequate food for a whole year. Food security is a prerequisite ensuring further welfare gains. Increased cassava production would enhance the food security of non-growers through increased market availability.

Challenges

Considering the activities undertaken, especially capacity building and the distribution of planting material, it is ironical that not many livelihood indicators were witnessed. Based on discussions with some members of IITA staff, a number of challenges were envisaged that might explain the limited evidence of livelihood outcomes.

Focus on research

The major focus of the project was on cassava research for development, especially the development of new varieties, processing technologies, food and nonfood products, and management practices. Management practices were, however, given limited attention compared with the development of new germplasm. Local varieties might not always be a bad choice, especially combined with proper management practices. Local varieties often had unique characteristics that compelled farmers to keep them in the absence of competitive improved varieties. This might explain the low adoption of the new varieties developed in the previous phases of SARRNET's activities. In any case, improved varieties also require better management practices. Emphasis on the development of the new varieties might have reflected the professional interests and bias of the lead implementers. In addition, the focus on research ignored the importance of tracking livelihood impacts during project implementation. Future interventions should integrate different professionals in the team.

Adoption rate

The activities such as capacity building and distribution of planting materials to potential beneficiaries could be done alongside monitoring the ways in which such interventions were translating into farmers' socioeconomic indicators, e.g., land allocation to the technologies, incomes, or food security. Baseline data on livelihood indicators were absent and this made it hard to quantify if there were any tangible changes in livelihood indicators, six years after the project's interventions. The indicators tracked during the project merely indicated whether the project had met its target. Not much livelihood gain could be extrapolated on the basis of such indicators. The project documents were silent on whether or not early adopters sustained the activities or if there were any dropouts, and if so, how many and for what reason. For example, in 2007, (see Table 9), a total of 3004 farmers had adopted various new technologies. However, in 2008, it was reported that 2910 farmers had adopted new technologies. Considering that these are cumulative adoptions, it implied that in 2008 effectively no farmer adopted new technologies and also that 94 of those who had previously adopted them had since then dropped the technologies. Monitoring of adopters as well as of dropouts and their associated reasons could have enabled some reflections on the approach or support to such beneficiaries. It could also have given some indications on the suitability and sustainability of the technologies beyond the period of project support. It was also not clear if the beneficiaries in subsequent years were entirely new or not. It might not be surprising that the survey could not capture large numbers of households, for example, those who were aware of or using new technologies, because it could be that the same few households that were being counted over and over again.

Unfinished activities

The project implemented a lot of activities in the pilot sites. A number of activities were not completed or if they were, they might not have been conclusive. The question is to what the extent the beneficiaries had benefited in the six years or for how long they would still have to wait before they could have the anticipated technologies. A number of factors may have contributed to unfinished activities including a lack of capacity to effectively undertake the activities or a lack of direction and priority among competing activities. For example, similar activities were started in the pilot sites but results were mainly available for Malawi. Even where it was acknowledged that data were being analyzed, conclusions were not clear.

Over-dependence on collaborators

The problem of unfinished activities could also be attributed to an over-reliance on collaborators, including NARS who might not have had adequate capacity to undertake the activities. Although SARRNET as a regional network is supposed to strengthen the regional capacity of NARS and not to replace them, it certainly needs to find better approaches to building the capacity of NARS, either through increased funding or by more training of the NARS staff who undertake such major projects. That was the guaranteed. sustainability that was sought after SARNNET ended its mandate.

It could also be a matter of a lack of motivation for NARS. Unless the lead persons in the collaborating institutions have tangible personal benefits (e.g., academic awards, financial gains) beyond institutional benefits, commitment might be difficult to guarantee. Project funding was disbursed on an annual basis and this might have brought some uncertainties over future funding or caused delays in the implementation of the activities. In Mozambique and Zambia, team leaders for NARS were physically very far distant, (over 1000 km) from the impact sites. Instead, the project relied on extension staff or other research staff who were working on other commodities and might have had a limited understanding of the project's activities and no accountability for project activities. IITA/SARRNET recruited staff to circumvent the capacity problems in Mozambique and Zambia. Their services were, however, terminated leaving a capacity gap that NARS could not easily fill.

Sustainability of the technologies

Almost all high-priced processing technologies (chippers, graters, solar driers, peelers, for example), were given free to the beneficiaries or heavily subsidized by IITA/SARRNET or partners. Similarly, planting materials were distributed free. Free handouts raise questions of the sustainability of their use, especially when maintenance and repair costs cannot be met without external support. For instance, it was not known how many of the processing machines given out during the project were still operational.

Lessons learnt and implications for future strategies

Appropriateness of the technologies

The low level of awareness and adoption, especially of the improved varieties released in the previous phases of SARRNET, raises questions and provides lessons regarding the appropriateness of the technologies. First, whereas the varieties might have been high yielding, they might not have been the most appropriate for the parts of the CT where cassava was not a food security crop. Households in non-traditional cassava areas preferred sweet varieties. This meant that the resources put on the development and dissemination of the bitter varieties might not produce the expected impacts. It was also questionable whether or not the development of the improved varieties was market-led, because one would have expected that the suitability of the varieties according to the preferences of the farm households and the target market could have been considered. It could have been clear at the onset that promoting bitter varieties, for example, in Malawi, would not lead to higher adoption. Future interventions should consider the preferences of the beneficiaries and the market demand before any further new varieties or technologies could be advanced. It is important to undertake market research to establish the determinants of acceptability and the adoption of new products and technologies.

Approach

Farmers' participation in the technology development process was one step towards ensuring their feedback as well as creating initial awareness of the technology being developed. Often, very few farmers participated in the technology development processes. More farmers tended to be reached through on-farm demonstrations and field days. To create the effective demand that could lead to a high adoption of the new technologies required more than just on-farm demonstrations or field days. It is important to undertake technology promotional activities even after the technology has been released. During the implementation of the current project, there were no major activities to promote varieties that were released in the previous phases. Varieties distributed for seed production were mainly for research. As experiments are ongoing, more effort would be needed to raise awareness about the new varieties and their associated benefits.

Prioritization

More activities were implemented in Malawi than in Angola, Zambia, and Mozambique. Understandably, the development of the cassava sector in these areas was different. In addition, staff at IITA/SARRNET's office in Malawi and their proximity to in-country pilot sites created a capacity advantage in implementing activities. The activities in the different pilot sites should have been prioritized on the basis of capacity and level of advancement of the cassava sector. Future interventions should not generalize the activities to be implemented in the CT. Due diligence should be given to the variations in the development of the cassava sector which should influence the type of specific activities to be supported first. For example, where relatively good varieties exist, on-farm demonstration trials should be the focus to raise the profile of the different agronomic practices necessary to increase yield.

Drivers of change

The dramatic surge in cassava production in the CT might not automatically translate into an increased demand for non-traditional cassava-based products if food security was the main driver. The wide range of high-value cassava-based products developed and tested during the project period might take time to be part of the traditional food basket. Moreover, high-value products are for the medium and high income markets which are beyond the reach of the majority of smallholders in the region. Creating demand for high-value cassava products may take more time and resources than were available in five years. A solid foundation has nonetheless been established and what remains is to change the mindset and perceptions about cassava in non-traditional uses where other products (such as corn- or wheat-based products) may be perceived as superior. Future efforts to commercialize the cassava sector should consider capacity building for smallholder farmers in improved access to markets and increased income. This may not necessarily mean the processing of cassava into high-value products (e.g., bread, scones) but also include supply aggregation so that farmers would benefit from collective marketing and reduced transaction costs of fresh cassava or easy-to-sell cassava products such as flour.

Incentives to invest

Large and medium-scale investments in the diverse cassava-based products whose production feasibility and economic potential have been established might require additional strategies. For example, the production of starch, high quality cassava flour, and animal feed might be a better avenue to commercialize smallholder-dominated cassava production. Smallholder farmers linked to these large and medium-scale businesses might increase production and trade volumes, thereby improving income. Such investors, however, would have to penetrate a market traditionally dominated by competitor products, such as corn or wheat products (starch and flour). They might also face the risks of competing with food security needs during lean maize periods as well as high transaction costs to bulk up supply from disparate smallholder producers. Future interventions should consider strategies to minimize supply risks and transaction costs, such as collective marketing through which smallholder farmers may bulk up supply and establish collection centers. In that way, smallholder farmers may effectively be linked to large and medium-scale businesses for increased incomes and improved livelihoods. Failure to organize farmers into collective marketing means retaining the increased production in the informal markets where prices remain low, value addition is limited, and postharvest losses are high.

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